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September 11, 1930

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# Engineering News-Record

McGRAW-HILL PUBLISHING COMPANY, INC.

MOUNTAIN RESERVOIRS

## An Issue Devoted To

# Sources of Water Supply

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Pirnie on Geology of Florida Wells
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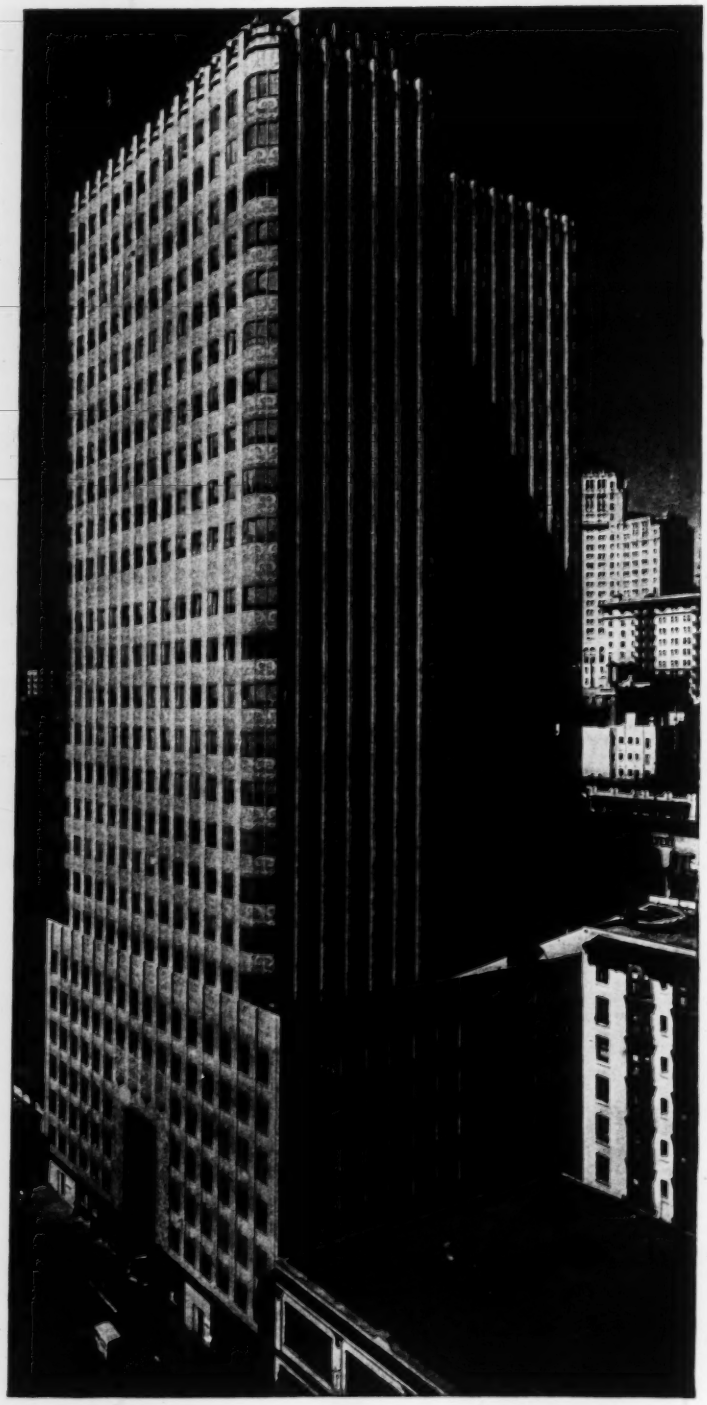

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# ENGINEERING NEWS-RECORD

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F. E. SCHMITT, *Editor*

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## Sources of Water Supply

### *A Symposium*

INTENSIVE study of the sources of water available for sustaining the existence of communities is the present day's need. For some years supply questions have grown in importance, and today constitute the foremost subject engaging the concern of the water fraternity. The present issue has therefore been arranged to present a symposium of the thoughts of leaders of the profession on the major phases of the subject.

The country is passing through an abnormal water season. Hot summer weather and prolonged dryness have taxed water supplies to their ultimate capacity in many parts of the country, and give prospect of continuing influence through low runoff and reduced reserves. Streamflow is still diminishing, and both surface and underground sources are receding. These conditions place remarkable emphasis on the meaning of adequate supply sources to both engineers and public. But drought was not needed to give the subject ample claim to attention. Its present commanding position is the result of natural progress. Water supply has been influenced profoundly by the country's growth and by the coincident advance of the art. Its technical problems, which once held first place, are now secondary.

Looking back twenty-five or thirty years we see that questions of pumpage, storage, purification and distribution then engaged closest attention; procurement of the supply was relatively simple. Since those days, however, demands for water have multiplied while the engineering difficulties of water distribution, from aqueduct to house spigot, were progressively being overcome. Increased density of population, more intense industrial activity and the present generation's extreme mobility have spread home building widely. Rural regions now are calling for extension of distribution systems. Old sources become insufficient and unsatisfactory. New ones must be provided.

Four months ago *Engineering News-Record* dealt with the art of purification and distribution problems, including also finance and administration. The present discussion of the underlying and closely related theme of sources of supply carries forward that contribution. It reviews by precept and example the leading considerations which affect the different kinds of source, in order that the increasing difficulties of providing water, and future possibilities, may be more justly appraised. It is our hope that the symposium will help to promote the sounder growth of the water-supply art.

## Interstate Waters

THERE is a cloud upon the public water-supply horizon. If it is not lifted by the United States Supreme Court in two cases now before it, our cities may be confined in choice of water supplies to intrastate streams. The cloud arises from an attempt to extend the common law doctrine of private riparian rights to include state control of interstate waters. If successful the attempt might ultimately affect most of the municipalities of the country, since those of our inland waters that are not interstate are relatively insignificant.

Six of our great drainage basins comprise together the major part of the area, population and industry of the entire country. The Mississippi basin alone includes 40 per cent of the area of the United States. North of it lies the Great Lakes basin. In the far West are the Columbia and Colorado rivers, each draining an immense area. Smaller in area but of great significance otherwise are the Connecticut and the Delaware river basins. The waters of four of the six basins just named have been or are now before the United States Supreme Court as regards some phase of municipal supply. There are threats that a fifth will be, leaving free only the Columbia River basin. These conflicts affect the water supplies of seven great metropolitan districts—Boston, New York, northeastern New Jersey, Philadelphia, Chicago, St. Louis and Los Angeles—comprising many scores of municipalities and some 15,000,000 to 20,000,000 people.

All these interstate water conflicts have arisen within the present century, most of them in the present decade. Their recent origin and rapid progress reflects the increasing demands upon the water resources of the country—demands bound to increase in number. They are a direct consequence of the rapid growth of cities and industries in number, size and proximity to one another, and a corresponding growth of water consumption. Auxiliary factors are increased stream pollution and rising quality standards for water supplies.

We have no administrative machinery to deal with interstate water-supply conflicts. Each state is sovereign except for powers delegated to the nation. Many of the states have boards to allocate and regulate their public water supplies. The nation has none. All it offers is resort to the federal courts. The one course open to prevent litigation over interstate waters is the power of the states to make compacts or treaties, subject to the approval of Congress.

Attempts were made in two of the pending conflicts to use this treaty method to apportion the use of interstate streams for municipal water supply, but both failed. The tri-state Delaware River compact, agreed to in an original and a modified form by commissioners, engi-

neers and lawyers representing each state, was accepted by the New York legislature only. The proposed seven-state Colorado River compact ended in a six-state compact, with one state standing out. These failures do not prove that compacts are impossible, but they do show that they may be beset with difficulties. Even in these instances they may be of material aid in final settlement of the controversies and point the way for success in other instances.

A closer look at the Connecticut and Delaware river cases now pending shows, first, that the complainants in both suits claim that the proposed diversion would injure navigation, power and the sanitary regimen of the streams. In addition, injury to agriculture is claimed in the Connecticut case. In the Delaware River case New Jersey claims damage to public water supplies, the fishing and oyster industries, and the scenic and recreational value of the river along the Delaware Water Gap. These are claims which, so far as proved to the satisfaction of the court, must be met by compensation to riparian owners. They embody no unusual principle in fact or in law. The novelty in both cases lies in a claim never yet passed upon by the supreme court of the United States: that no diversion whatever can be made without the consent of the lower state concerned, which in these cases are Connecticut and New Jersey. In other words, state sovereignty over interstate waters is claimed, even to the extent of denying another state the right to utilize any part of the tributary water gathered within its own boundaries.

The attempt to apply such a doctrine to these projects is all the more startling because in each of them flood-flows only are to be diverted, while in one of them, the Delaware River project, stored water would be let down stream in times of minimum flow. These cases are unprecedented. The nearest parallels involve the use of water for irrigation, taken under the doctrine of prior appropriation rather than of riparian rights.

If the supreme court should uphold the Connecticut and New Jersey claims of state sovereignty over interstate waters, every state possessed of interstate waters—and what states are not?—would be able to dictate the terms of the use of any part of them in any other state, even on headwater sources wholly within the other states. The only exceptions would be such uses of water for navigation and for power as are within the control of the federal government. The far-reaching threat of such state power, in view of the extent of our interstate waters and the large and growing demands for their use for many purposes, is appalling. The menace to needed takings for public water supplies would be the most serious of all.

Although there are no adjudications on the specific question at issue, other decisions of the United States Supreme Court, in both water rights and other cases, lead one to hope that no such extreme doctrine of state sovereignty as is claimed by Connecticut and New Jersey will be established, but that each state will be permitted to draw upon the natural resources of the country in equitable measure.

The decision in the Connecticut and Delaware cases will be awaited with serious interest, for upon it the future welfare of our cities and industries is largely dependent. Whatever the nature of the decision it is sure to emphasize the need for thoroughly defined basic principle of rights, and for administrative machinery adequate to deal with the interstate water-supply problems that are arising on every hand.

# Dry-Weather Experiences

IT APPEARS inevitable that over a large part of the country the 1930 rainfall and streamflow records will set new all-time lows. Cumulative precipitation for the year is far below normal, and the season in which some degree of recuperation can be expected still some weeks in the future. The effects of this exceptional experience upon the country's water resources are already evident, and they will exert long-continuing influence on the water art.

Hydro-electric plants have already taken emergency measures to insure production of power. Many are shut down or are operating at partial gate openings, and have passed over to the steam plants a greater portion of the load than ever before at this season. Dwindling domestic water-supply resources have become a serious problem to more communities over a wider area of the country than at any previous time in the history of modern engineering.

Large cities which rely on storage reservoirs to carry them over periods of low streamflow have witnessed constantly falling water levels behind their dams, and small villages have seen their well systems handicapped by a receding groundwater level. As water supply has no stand-by service comparable to that available in power production, the shortage of water is likely to become acute in many localities before the cycle of the seasons brings about recovery. Extreme effort will be necessary to curtail waste and non-essential use of water by the consumer.

Aside from causing water shortages the long period of low streamflow is likely to have another grave effect by threatening the safety of many supplies. The reduced volume of water for diluting the wastes which enter the streams may result in dangerously high concentration of organic matter. As a result many streams which are ordinarily safe must be used with great caution and subjected to unusually thorough treatment if waterborne diseases are to be avoided.

Present diminished streamflows are in general traceable directly to reduced precipitation in the last six to twelve months. But groundwater resources that have been depleted over a much longer period appear to be at least partly responsible. Since this theory was suggested recently in these columns evidence has accumulated indicating its soundness. For example, some of the highly developed streams in the Southeast on which accurate records are available show greater reduction in runoff than might be expected from the deficiency in precipitation on their watersheds this year. The theory that long-time depletion of groundwater has an effect on the flow of streams for periods some time following a drought is not to be dismissed lightly.

When the final figures for the 1930 runoff get into the official streamflow records, they will be significant for years to come. Prediction of future needs can be made only in the light of the records of the past, and the minimum recorded flow of a stream plays an important role in water-supply design. Mass curves for many streams will show much more decided dips for the 1930 season than for any previous period, and frequency studies will reveal new limits of runoff.

Present low-water conditions also show the need of hydrologic data reaching much farther back in the history of streams than records now available. There is need to dig out from sources antedating these records general information that will at least throw light on

what may have happened in the past in the way of excessive droughts or serious low water. In arid regions, where life and industry depend largely on the minimum dependable supply of water, engineers have been diligent in cultivating sources of information not yet touched in the better watered sections of the country.

Old newspapers and letters, tree-ring growths studied in the light of other contemporaneous climatic conditions, and other facts constitute possible sources from which a skilled investigator might unearth data bearing on minimum streamflows long prior to present official records. Cautious interpretation of such general information is necessary before it can be used with any degree of confidence, yet it should make possible at least a long-range limiting hindsight that would permit more definite projecting for the future. The present dry period emphasizes the need for some guide that goes long back of the records on which most localities must now depend. It also points to the desirability of establishing additional meteorological and stream-gaging stations in order that the scanty records of the present may not hamper engineers when the next low rainfall period comes upon us.

## Brief Notes

### *Florida Waters*

LYING quite outside the normal routine of water problems, the water conditions of Florida are interesting in their complexity. The geological formation underlying the region is like a sponge cake placed on a huge Swiss cheese, permeated by the salty waters of the surrounding ocean and gulf. Fresh water is found on the hilltops where the holes in the cheese have been enlarged by downward leaching waters. Great springs abound. There are heavy underground flows. Some parts of the state are dotted with lakes. Many sink-holes are found. Exact data are meager, however, and when needed call for extensive researches. Once the physical facts are found, it is easy to predetermine the yield of certain gathering areas, because rainfall less evaporation and transpiration gives the answer. The hydraulic mechanism of the interaction of fresh and salt water—the latter holding up the head of the fresh water contained in the passage of the cheese—is essential to practical uses. Such an intriguing hydraulic problem is not often met with. Ponce de Leon can not be blamed for his enthusiasm over the springs he found. The waters of Florida still are marvels.

### *Water From Underground*

MOUNTAIN-PIERCING aqueducts and disease-preventing purification plants have received the lion's share of the attention the world finds time to give the problems of water supply. Yet the homely well and spring still remain the most frequently used supply among civilized people. More municipalities in this country supply themselves from the water stored beneath the ground surface than draw on surface streams.

Development of these underground supplies is less spectacular or romantic an undertaking than the construction of a large dam or long tunnel, but it must be based upon equally sound engineering principle if successful operation is to be obtained. The basic essentials are stated clearly and definitely elsewhere in this issue. Their fundamentals lie in an appreciation of the fact that there really is no ultimate source for any water supply; there is instead a continuous and inevitable cycle of ocean evaporation, precipitation on land, drainage to watercourses either by surface runoff or groundwater percolation, streamflow toward the ocean, and evaporation again.

The engineer's problem is to determine the best place to intercept this cycle in order to substitute a comparatively short auxiliary path of his own choosing for the usual long route. When he selects the pervious soil layers as the point in this endless path at which to extract the water for community purposes, to avoid failure he must give full attention to the antecedent part of the cycle. The precipitation must be ample; the drainage area must be sufficiently large in extent; the transmission capacity of the soil must be adequate to answer his requirements. Were all the data available it would be possible to compute the capacity of a given development as accurately as any other hydraulic problem. But many of the necessary data are geological, and frequently they cannot be obtained. For that reason recourse must be had to information of a less direct nature, such as experiences with similar supplies in the same region. A large element of judgment must always enter into a final solution, but that judgment must still be based on these same fundamental principles. The day of divining rod and water dowser has passed, and engineering is as fully requisite in dealing with underground waters as with streams and lakes.

### *More Water Softening*

GROUNDWATER in limestone areas becomes heavily mineralized by taking up chemical compounds from the rock through which the water percolates. Such hard water is in many ways objectionable and harmful as a city supply. Not only groundwater but many surface waters have hardness. The Southwest, upper Middle West and certain areas of the Missouri Valley are particularly troubled by excessively hard water. Yet only a beginning in water softening for cities has been made.

In the semi-arid and arid regions often no other water is available, and the inhabitants have to accustom themselves to using hard water—not always an easy or a pleasant experience. The human economy rebels against salts in too great quantity or of too many kinds. Hair and skin become harsh and dry. In any part of the country hard water is objectionable because it is disagreeable, increases soap consumption and requires more labor and cost, both in the home and in the industrial plant, rather than because it is a hazard to health. But these shortcomings are so weighty as to demand that softening be included in any water-supply project depending on a hard source.

Wider dissemination of accurate information on softening both well and surface waters is seriously needed. Something has been done in education and performance by the railroads, utilities and other steam power users, because of the physical effect of such waters on boilers, but education of the general consumer has made comparatively little progress. He it is that must be convinced of the desirability of a softer water. Not one in ten of the hard supplies of the country is softened. A rich, uncultivated field is open for the consultant as well as seller of equipment. Probably no activity in the wide range of water requirements is so unoccupied as that of water softening. Is an association for research and for education not the next step?

# Groundwater as a Source of Supply
## —*Limitations, Types and Precautions*

### Usually of Excellent Sanitary Quality but Often So Highly Mineralized as to Be Useless—Relation Between Rainfall and Available Capacity Needs Careful Consideration —Geological Conditions Important

By Charles B. Burdick
*Consulting Engineer, Chicago*

**Numerous small cities and towns of this and other countries, and occasionally a community of considerable size, get their water supplies from underground sources. Conditions of selection, construction and maintenance of groundwater supplies are many, and some are complex. Four articles in this issue deal either with the general problems of underground waters or with specific developments and projects. The first of these, herewith, is a broader general review. Mr. Burdick's analysis of the problem of underground supplies points out, among other things, that such waters are usually of good quality but often highly mineralized, that drawdown is an important element in pump selection and that a knowledge and appreciation of geology is necessary to economic development. The reader should familiarize himself with these important factors, since they are treated separately and in detail in the succeeding articles. —*Editor.***

WATER obtained from the ground is usually of high quality as to freedom from bacterial content but often contains in solution sufficient mineral material to render it unfit for use. Originating in precipitation, it percolates through the porous strata below the surface and finds its way to the open water courses. Between 30 and 40 per cent of the precipitation can usually be expected to enter the ground and be available for development. The filtering abilities of porous strata are sometimes utilized by installing an infiltration gallery adjacent to a stream.

In developing groundwater by the use of wells, community supplies must usually depend on the flow through the coarser sands. Some localities have available a deep water-bearing stratum in which the water is under sufficient pressure to lift it above the elevation of the ground. When pumping must be resorted to, the type of equipment most suitable depends upon the level of the groundwater and the characteristics of the porous stratum. Preliminary investigations must give attention to the geology of the district as well as the data obtained from previous explorations.

From earliest times the clear and cold waters from the ground have been highly prized for domestic use. At present, several hundred of the smaller cities and towns and many larger ones up to a quarter of a million people are thus supplied. Throughout the northern part of the Mississippi valley, the greater part of Texas and in many localities on the Atlantic and Pacific slopes, it is quite generally the supply of the villages and the smaller cities.

Wells are the most common source of water supply for the farm or small rural community. Sufficient groundwater for such use is almost everywhere available in the habitable area of the United States. The problem to develop enough of it becomes difficult only when the demands of the population concentrated at one place exceed the absorbing and carrying capacity of the soils and rocks that underlie the surface of the vicinity. Generally speaking, cities of more than 100,000 population have found it impracticable to develop sufficient underground water, and resort has necessarily been had to the surface sources. Where the underground conditions are specially favorable, however, many cities of smaller population and some considerably larger have found it feasible to develop good and adequate groundwater supplies. A number of localities have been observed where supplies for large populations could be developed, although no use for the supply exists at present on account of the remoteness of habitation.

*Character of Groundwater*—Early in the study of bacteriology it was noted that groundwater was comparatively free from bacteria and that the cities served by groundwater suffered little from water-borne diseases. Unfortunately, however, in its travel from the place where it falls on the ground to the place where it is developed, the water dissolves various mineral substances to a greater or less extent and may become so highly mineralized as to be unfit for domestic use. Many waters that are good to drink are so hard that they are undesirable for industrial and household use. Quite frequently they contain iron or manganese in such amount as to injure their usefulness greatly. Today many of these highly mineralized supplies are softened and purified and constitute the best available source in their localities.

Generally speaking, where the bedrock of the locality is granite or other relatively non-absorbing rock and where the detritus overlying it consists of the abrasions from igneous rocks, the groundwater is quite soft and well adapted to domestic use without treatment. At a number of places along the northern border of the United States, as far west as Lake Superior, these favorable conditions are found. Where the igneous rocks are overlain by limestone and later deposits derived from the sedimentary rocks, the water is likely to range from moderately hard to very hard. Wherever the surface waters pick up carbon dioxide from decaying vegetable matter on the surface, they have the ability to absorb iron and manganese, which sometimes makes them very objectionable. Conditions are rare, however, in which the hygienic quality of groundwater is bad, because the surface of the earth is largely made up of granular materials well adapted to filter out bacterial impurities at the slow rates at which water percolates through the ground. Exceptions occur when the groundwater passes through crevices in rock or solution passages without having been thoroughly filtered at the surface.

*Origin of Groundwater*—In pumping water from the ground, it is sometimes forgotten that all groundwater originates from rainfall and that for a successful permanent supply there must be a tributary area sufficiently large to absorb the required amount and enough transmission capacity below ground to carry the water from the place where it falls to the place where it is developed and pumped. When the rain falls a portion of it is at once absorbed by vegetation. A part of it sinks into the soil and is re-absorbed by the roots of plants. When the precipitation is sufficiently intense a portion of it

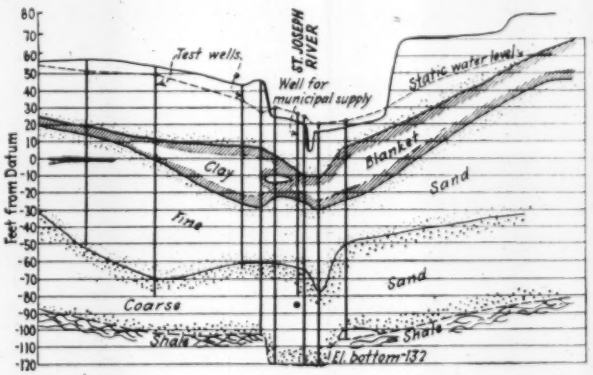



FIG. 1—CLAY BLANKET PREVENTS INFILTRATION FROM POLLUTED RIVER AT SOUTH BEND

runs off directly into the streams, and a portion in the supersaturated soil passes beyond the reach of vegetation and enters the underlying soils and rocks. If the underlying materials are sufficiently porous, the groundwater travels through them, following the general slope of the ground toward the nearest watercourse, into the bed of which it seeps as it is forced forward by ensuing rainfall. This furnishes the low-water flow of the streams.

Such travel of the groundwater is extremely slow under the ordinary conditions of porous sands, generally only a few inches per day even where conditions are most favorable. The rapidity of flow at a given slope of the underground water surface, however, varies approximately as the square of the size of the grain of the material through which the water flows. Thus the finer gravels are great water producers, but the rate of flow is scarcely perceptible through very fine sand. Much the same thing occurs when the groundwater seeps into the underlying rock formations. Most of the rocks are practically impervious. Limestone permits the passage of the water through crevices and solution passages. Some sandstones are sufficiently porous to deliver considerable water through the body of the formation itself, but the capacity is relatively small compared with coarse sand.

*Limiting Capacities*—An inch of rainfall per month, all entering the underlying soil, is equivalent to about 580,000 gal. per day per square mile. Under ordinary circumstances where the yearly rainfall is from 30 to 40 in., 12 in. per year entering the subsoil is about as great a supply as can be depended upon. This has been determined in a few cases where watersheds have been developed to their full capacity and where the catchment areas were reasonably well defined.

Brooklyn Borough of New York City is located upon Long Island, a huge sandbar, so to speak. From these sands it develops probably more city water than any other locality in the United States. About 30 m.g.d. was developed in 1906 from saturated sand varying from 100 to more than 200 ft. in thickness. A thorough investigation for the extension of this supply indicated that about 800,000 gal. per square mile of surface per day could probably be developed. This is equivalent to 17 in. in depth per year.

The situations are rare where the underlying materials are sufficiently porous and deep to permit of very large quantities being drawn to one spot. Generally, the collecting works must be spread out so as to develop sufficient area and secure the necessary underground transmission capacity to deliver the water from the place where it falls to the place of development.

*Infiltration*—Under natural conditions the subsoil water flows toward the nearest watercourse and the surface of the groundwater everywhere lies above the stream, rising quite rapidly with the ground away from it. Although farm supplies can be obtained almost anywhere in a well-watered country, the supply for a town can usually be most easily developed in the valley of a watercourse, for this is the lowest part of the catchment area and usually at the place where the underlying materials are coarsest. If the supply drawn at any one place is less than the supplying capacity of the tributary area and the transmission capacity of the intervening material, the water drawn will all be so-called groundwater originating from rainfall. But if the supply is developed close to a stream and if the groundwater surface is depressed much below the surface of the stream, the conditions of nature are altered, a negative head is placed upon the bed of the stream and, if the bed is porous, some water will percolate back into the underlying sands.

The water supply at Des Moines, Iowa, typifies a situation where nearly all of the water developed is derived from percolation from the bed of the Des Moines River

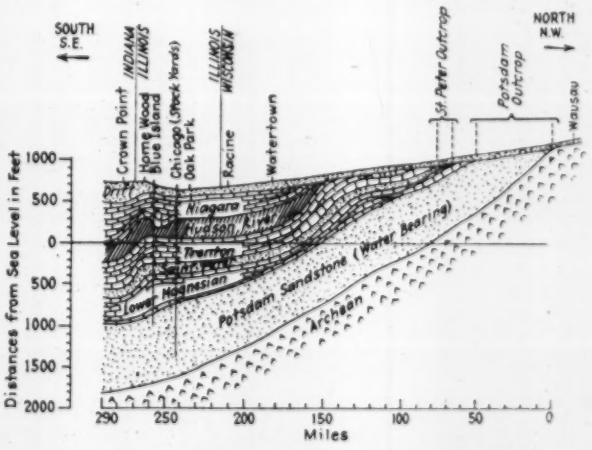



FIG. 2—GEOLOGICAL CROSS-SECTION THROUGH TYPICAL ARTESIAN REGION

Section taken on line running northwest from Chicago, Ill., through Wausau, Wis.

by collecting galleries located on land about 200 ft. or more from the water's edge and paralleling the course of the river. This installation has been successful in developing a minimum of 300,000 gal. per day per acre of riverbed subjected to negative head. The river flows through a valley about one mile in width, in which the bottom and sides of the valley consist of impervious formations with the bottom overlain by water-bearing sand 10 to 20 ft. or more in thickness. The galleries are built on the land some distance from the bank of the stream in order to promote comparative uniformity of infiltration. The supply is supervised by a sanitary chemist and gives substantially the same result as a modern filter plant.

43,560 sq ft/acre 43,560 × 640 = 27,878,400 sq ft/sq mi ÷ 12 = 2,323,200 cu ft/sq mi × 7.48 = 17,400,000 gal/sq mi

17,400,000 / 30 = 580,000 gal/day/sq mi.

Where streams emerge from a mountainous area, it is quite common that a gravel cone is formed at the foot of the mountains. Frequently, this is very coarse material. At seasons of low water it is not uncommon for such streams, upon emerging from the mountains, to disappear entirely into the porous formations constituting the streambed. Sometimes large quantities of underflow originate in this way. The Arkansas bottoms in western Kansas thus yield water for irrigation when pumped through wells, and similar situations occur at numerous places throughout the United States. The methods for developing supplies from such sources differ in no important respect from the development of upland groundwaters.

Upon the low plains of the Arkansas and White rivers in central Arkansas, the water from the underlying sands is widely used for the irrigation of rice. In this case the saturated sands are developed by tubular wells, usually packed with gravel and of diameters from 18 to 30 in. The water is pumped with vertical-shaft centrifugals, most of them driven by electric motors. There are about 700 installations lying northward from Pine Bluff within an area of not more than 50 square miles, developing from 1 to 2 m.g.d. each during the growing season. A large part of this water returns to the underlying sands after it has served its purpose on the surface.

*Types of Development*—The types of development and the methods of pumping vary widely with the local circumstances. So far as municipal supplies are concerned, developed from materials overlying rock, only the coarser sands have significance. Around the foot of Lake Michigan there is a deposit of sand ranging up to 50 ft. in depth below lake level consisting of comparatively fine clean sand with an effective size of from 0.15 to 0.20 mm. In this situation only a small village could be supplied by a practical development of wells. A 6-in. well in this material will yield only 5 to 10 gal. per minute per foot of drawdown. In the valley of the Mississippi above the southern Wisconsin line, large beds of sand are found of as much as 200-ft. depth or more that will average from 0.2 to 0.4 mm. effective size. Large supplies of water can be drawn under conditions such as these, 10-in. wells producing 20 to 30 gal. per minute per foot of drawdown.

At LaCrosse, Wis., five groups of four 10-in. wells each, about 1,000 ft. between groups, with wells located on the corners of a 100-ft. square, deliver about 2 m.g.d. per group when required; ordinarily not more than two or three groups are operated simultaneously. Many situations exist, with capacities varying between the two extremes mentioned. There are a few instances where a few feet of clean pea gravel can be made to deliver as much as many feet of sand.

The means used to collect water from saturated granular materials include driven wells carrying fine strainers, tubular wells with strainers set from the inside of the tube which become effective after the casing is drawn, similar wells packed around the outside of the strainer with coarse gravel, and open wells consisting of a masonry curb and having an open bottom through which the water enters. These last-mentioned wells are often of considerable diameter. Of late years, where coarse sands are available, wells 2 to 4 ft. in diameter have been widely used, consisting of steel or concrete tubing sunk to the required depth with relatively coarse openings near the bottom for the admission of water and packed about with pea gravel sunk around the outside of the casing. Under certain circumstances high-capacity wells can be built in this way, and it is claimed that they are free from the strainer stoppages which sometimes occur in the course of time where a fine strainer is used.

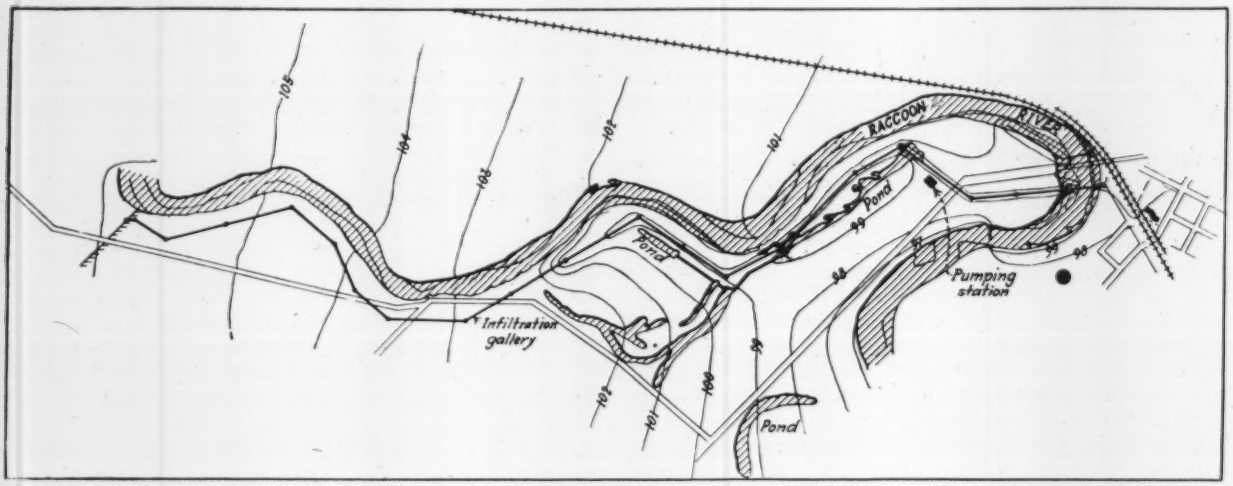



FIG. 3—INFILTRATION FROM RIVER SUPPLIES WATER FOR DES MOINES, IOWA
Ponds flooded during times of low water in river in order to increase rate of filtration.

*Deep Groundwater*—Much of what has been said refers to the development of water in the granular materials overlying bedrock. A large amount of groundwater is developed from wells within the bedrock, ranging in depth from 50 to 100 ft. to 2,000 ft. or more. These supplies are subject to the same general principles as the supplies drawn from the overlying soil. Generally, the gathering ground for the water is not easily defined and the transmission capacity underground can be determined only by practical experience.

In a number of instances artesian conditions are present where the source is sufficiently elevated and the transmission medium is confined by overlying impervious materials. Similar conditions sometimes exist in glacial drift. The great artesian area underlying the northern third of Illinois, eastern Iowa and southern Wisconsin typifies this water-supply situation. Similar conditions are prevalent in Texas, South Dakota and elsewhere. In the Illinois artesian area the principal supply is derived from the Potsdam sandstone, generally 500 to 1,000 ft. in thickness, with its top at varying elevations

up to 1,000 ft. below the ground surface. This water-bearing sandstone has its outcrop in central Wisconsin over an area of about 2,000 square miles, at an elevation generally about 500 ft. higher than the ground surface where the supplies are developed in Illinois. Originally, when wells pierced the overlying impervious materials, copious flowing wells were obtained. At a few places, where the draft of water has not been greatly increased, the wells still flow. In the region of Chicago, however, the rapidly increasing draft of water has caused the artesian head to be used up in friction. Wells that formerly flowed now have to be pumped, often from a depth of as much as 300 ft. below the ground surface. The general rate of fall in the region of Chicago has approximated 4 ft. per year.

It is common practice to develop the water from the Potsdam sandstone by tubular wells. The earlier wells were 10 to 12 in. in diameter at the top, sometimes reducing 6 or 8 in. at the bottom. Supplies of 1 m.g.d. were frequently obtained by artesian flow. It is the more recent practice to drill wells 15 to 18 in. in diameter to a depth well below the water line and thence to continue downward, finishing about 12 in. in diameter. Such wells, when equipped with air-lift or vertical-shaft deep-well pumps, sometimes deliver from 1 to 2 m.g.d., or 2 to 10 gal. per minute per foot of drawdown. In a few cases, as at Argo, Elgin and Rockford, these supplies have been pumped through a system of tunnels placed well below the groundwater plane, in which suction pipes tap the wells, permitting the use of high-efficiency pumps of large capacity.

*Methods of Pumping*—The methods of removing groundwater embrace practically all the devices used for the pumping of water and utilize practically all the

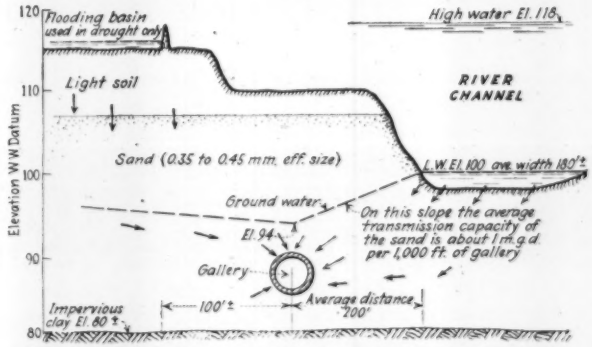



FIG. 4—TYPICAL SECTION THROUGH DES MOINES INFILTRATION GALLERY

Sand comprising riverbanks acts as filter to remove polluting material from water.

sources of power used elsewhere. In recent years electricity has been widely used; it has the advantage that it can be applied in numerous isolated locations.

For small supplies from wells of small diameter there is probably nothing better than the plunger pump with its barrel submerged in the bore of the well and actuated by pump rods driven by a windmill or electric power head. Such pumps are commonly used by estates, large institutions and small villages. When the development per well is large and the water plane lies at a considerable distance below the surface of the ground, the vertical-shaft centrifugal pump is widely used, often delivering from 1 to 2 m.g.d. from deep wells of 12 to 20 in. diameter. Where the water plane is close to the surface of the ground and does not drop too rapidly when pumped, the water can be drawn by direct suction from one or more wells, sometimes from a large gang of wells, thus securing water at high mechanical efficiency.

Where the pumping lift is high and the wells are of sufficient depth, particularly when the wells are located reasonably close to the power station, the air-lift pump can be profitably employed. This device, while having a comparatively low mechanical efficiency, is relatively inexpensive in first cost, and as there are no moving parts it requires very little in the way of repairs. The air-lift pumping equipment suffers with all other types of deep-well pumps in that its economy may be destroyed by material changes in the level of the underlying water. For best results each device must be reasonably well proportioned to the delivery and head.

*Groundwater Investigations*—If one could see under the ground, it would be possible, with the present knowledge of hydraulics, to make computations of groundwater yield with some accuracy. In some cases the underground conditions can be very well determined. This was done in the development of the Des Moines water supply. The depth and coarseness of the underlying materials could be determined by comparatively shallow borings and the flow of the groundwater could be studied by observation of the slope of the groundwater surface. An investigation of this kind, even where the underground conditions cannot be exactly determined, is often sufficient to permit estimates that will place a maximum limit upon the available supply, useful in determining whether the supply can be depended upon for a growing city. As in many engineering investigations, an ounce of fact is better than a pound of theory. Therefore, the limitations of the problem can sometimes be determined by a study of local geology, aided by patient inquiry as to the result of previous explorations underground for various building purposes and through comprehensive tests of developments already made.

One of the pitfalls that should be avoided is the development of apparently capacious underlying water-bearing materials not supplied by sufficient gathering ground. If the gathering ground cannot be determined through a study of the local geology, it is advisable to conduct pumping tests over considerable periods. Several instances have been observed where wells of high capacity were pumped practically dry within a period of a few weeks by continued pumping operation.

With the rapid growth of cities and the demand for a softer water, a number of the underground supplies have been abandoned in favor of a filtered water from surface sources. It is now practicable to soften groundwaters and to rid them of iron and manganese, sometimes present in objectionable amounts. Many groundwaters are comparatively soft and well adapted to domestic and industrial use. They will doubtless remain the favored source of water supply for the smaller cities and villages.

## Mississippi River Bridges *(Correction)*

In the article on the numerous new highway bridges across the Mississippi, in the July 31 issue, p. 181, some credit was misplaced owing to a change in one of the engineering firms mentioned. Thus the bridges at Louisiana, Mo., Alton, Ill., Cape Girardeau, Mo., and Vicksburg, Miss., and the Missouri River bridge at Bellefontaine, Mo., all credited to Ash, Howard, Needles & Tammen, were actually handled by the former firm of Harrington, Howard & Ash. This firm was dissolved early in 1928 and was succeeded by the present two firms of Harrington & Cortelyou, and Ash, Howard, Needles & Tammen.

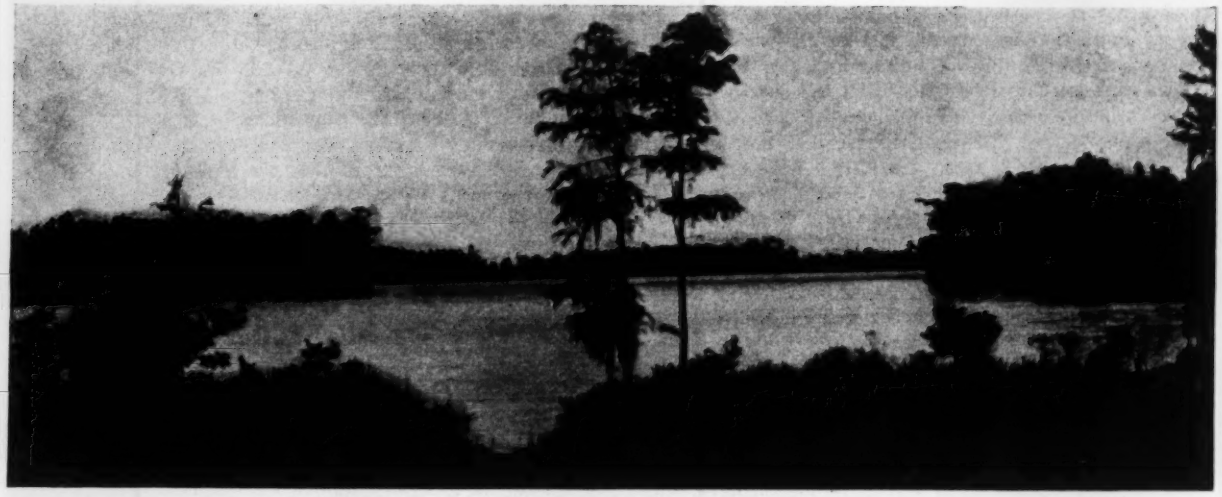


FIG. 1—TYPICAL FRESH WATER LAKE IN THE WELL FIELD
Lakes are in sink-holes continually getting deeper as underlying rock passages are leached out.

# Lake Clusters Reveal a Florida Groundwater Supply

## Salted Well Troubles Studied for St. Petersburg Area Until Limitations of Possible Drawdown Are Learned—Depth of Sea Outlets Determines Ultimate Capacity of New Well System for the City

By Malcolm Pirnie
*Consulting Engineer, New York City*

SEARCH for a new source of water supply for St. Petersburg, Fla., was made imperative because the wells drilled into the underlying rock and furnishing an excellent quality of water had become badly salted and little improvement had been secured from additional wells located away from the original well field. Salty wells are not uncommon in the St. Petersburg area. About ten years ago the Tampa supply became so salted that it was abandoned for a filtered surface supply taken from the Hillsboro River. In the flat woods area north of St. Petersburg the little town of Pinellas Park is supplied with a hard salty water from a 500-ft. well. The towns of Dunedin, Clearwater, Bellair and Largo are still enjoying fresh water from wells, although Clearwater has been forced to abandon its wells near the Gulf coast and to drill new ones farther east toward the higher land. The town of Oldsmar, or Tampa Shores, on the north end of Tampa Bay also has a salted water supply. Such a history of well supplies in Pinellas peninsula and on the east shore of Tampa Bay gave little encouragement of finding a fresh water supply in Pinellas County adequate for St. Petersburg.

In the research undertaken to locate a new supply an exhaustive investigation was made of the geology of the underlying formations, history of salted wells, effect of depth of submergence of ultimate outlets of the groundwater in the heavy salt water of the sea and gulf, and of the precautions necessary to keep the salt water depressed below the level of the bottom of the wells.

*Geology*—Knowledge of the geology at present is limited by lack of authentic records from most of the existing wells and almost complete absence of topographical surveys. First in a study of the groundwater supply of Jacksonville, early in 1927, and then in a search for the new groundwater supply for St. Petersburg, use was made of all existing data published by the U. S. Geological Survey and the Florida Geological Survey and valuable assistance was given by Herman Gunter, state geologist.

The entire state of Florida is underlain with limestone, the principal top rock of which is known as Ocala limestone. Fig. 3 shows the surface contours of the Ocala rock, which are approximately recorded from surface outcrops near Ocala and from wells drilled at various locations throughout the state. Beyond the coast line, however, the slope of the Ocala is simply assumed by the writer to continue until it intersects the face of the continental shelf somewhere under the Atlantic Ocean, the Straits of Florida and the Gulf of Mexico.

Wells which have been drilled for oil indicate that the limestones underlying the surface of the Ocala have a depth of more than 3,000 ft. In all such wells salt water has been encountered at a depth of 3,000 ft. or less. Above the Ocala rock surface there are in many places other limestones of more recent formation. In the vicinity of St. Petersburg and Tampa, the Vicksburg and so-called Tampa formations are deposited directly on top of the Ocala limestone 200 ft. or less in

thickness. The Tampa formation or top of this younger limestone outcrops on the surface in Hillsboro County, northeast of Tampa and along the Gulf coast of Pasco County. The rock in most areas is covered by a blanket of sand in which are lenses of clay.

In the vicinity of Miami there is a deposit of limestone of most recent formation known as Miami oolite. This is a thin layer deposited upon the sands and clays which overlie the Ocala rock. The latter at this point is about 1,500 ft. below sea level.

As shown in Fig. 3, the Ocala rock is at an elevation above sea level over a considerable area in the vicinity of Ocala; in certain places it is more than 50 ft. above. This country abounds with sink-holes which serve to carry off the rainfall. There are, in fact, many townships throughout this region in which there is not a single stream of flowing water.

**Supplementing Mr. Burdick's general review of underground sources of water supply, Mr. Pirnie takes up the specific problem of a single city. In covering it, he throws light upon the underground water problems of a region little studied until its rapid growth in population raised water supply to major proportions. Most problems of water supply in Florida differ materially from those elsewhere, but the difference is particularly notable for underground waters. Florida artesian basins discharge into the Atlantic or the Gulf of Mexico and therefore wells are likely to become salty—as also has been the experience in the wells on Long Island used by Brooklyn. In Florida, solution cavities and passages in the limestone introduce a factor not common elsewhere. The problem at St. Petersburg, as worked out by Mr. Pirnie, was first to find a supply ample and reliable in quantity, then to control hydrostatic conditions in such a manner as to exclude sea water. —*Editor.***

*Florida Resembles a Filter*—The peninsula of Florida may be likened to a great filter bed. The solution passages in the underlying rock are the filter underdrains which discharge below sea level in the face of the continental shelf. On top of the underdrain system in the vicinity of Tampa is a secondary underdrain system formed by the Tampa rock. Above these rocks is a blanket of sand containing lenses of clay. This blanket is clogged over very large areas by hardpan formations or continuous deposits of marl or clay. The surface of the filter bed rises only occasionally to a height of more than 200 ft. above sea level, and the greater part of the area is less than 100 ft. in elevation.

The rainfall that enters the rock dissolves some of the limestone and has produced very large solution passages in it. When the ground over such a passage caves in, a sink-hole is formed. The existence of these passages is also indicated by springs. Silver Springs, near Ocala, has a discharge of 545 sec.-ft. of fresh water containing 274 p.p.m. of solids. Accordingly, this spring discharges approximately 400 tons of dissolved rock per day. Blue Springs, near Dunnellon, discharges nearly 700 sec.-ft. of a water carrying 112 p.p.m. of solids and discharges 210 tons of dissolved rock per day. It is not uncommon to obtain yields of over 2 m.g.d. from 10-in. wells penetrating 100 ft. or more into the limestone rock. It is, therefore, obvious that solution passages of great capacity exist in the limestone rock under the entire Florida peninsula.

Water reaches the underdrains in various ways. Extending from a point northwest of Lake Okeechobee northward through the central part of the peninsula is a high sandy area known as the Highlands section. Here there are many deep lakes. These lakes have formed at points where water from the rainfall has found its way in considerable quantities through the sand into the underlying rock. The rock has been dissolved by the water entering it, until it has caved in and sunk the surface material below the groundwater level. These lakes are constantly growing deeper. They are surface markers of the points where water from the rainfall is entering the underdrains in relatively large quantities. This Highlands lake region is an important source of supply of fresh water to the underlying rock.

The higher the elevation of the porous soil the greater will be the tendency of the groundwater replenished by the rainfall to flow downward into the underlying rock. In the Ocala region the largest proportion of the rainfall enters the rock through sinks. In the sand-blanketed areas the proportion of annual rainfall entering the rock from the sand is in a general way proportional to the elevation of the ground. This does not apply to extended clay and marl areas or to flat woods underlain with hardpan. When rain falls upon such areas it runs off slowly.

Along the coastal plains, wells drilled into the rock flow relatively large quantitites of water. The elevation to which the water rises above sea level varies according to the location of the well. Northwest of Jacksonville a head of 70 ft. was recorded. The head at St. Augustine is less than 40 ft. The head at New Smyrna is a minimum at 13 ft. Farther south along the east coast the head increases. Several observers have found that the head in wells is affected by the tide. Wherever it was possible to secure approximate elevations of groundwater head in wells, these were plotted and contours of equal elevation of groundwater head drawn, as shown in Fig. 3. The high head areas underlie the known intake areas.

The discharge from the large springs in the vicinity of Ocala causes a reduction in the head as the water approaches the springs. Lower head is also found in wells where the surface of the Ocala rock apparently outcrops at a relatively high elevation under the ocean or gulf.

*Why Head Is High*—Sea water has a weight approximately 1.026 times the weight of fresh water obtained from wells in the Ocala rock. If a long tube were immersed vertically in the ocean and fresh well water were poured into the upper end of the tube until the level stood 1 ft. above the sea level, the depth of fresh water in the tube would be approximately 39 ft. It would have depressed the salt water 38 ft. below sea level. If the tube were long enough so that the fresh water level could stand 26 ft. above sea level, the salt water would be depressed 1,000 ft. below sea level. The solution passages, acting as submerged pipes under the peninsula, discharge at different depths below sea level. At the points of outlet the sea water exerts a back pressure on the flowing stream of fresh water in direct proportion to the depth of the outlet below sea level. Therefore, to cause a flow of fresh water through a solution passage into the ocean or gulf, the groundwater level must rise first to the elevation above sea level necessary to equalize the salt water back pressure and then rise to an additional elevation to overcome the friction loss of the flowing stream in the solution passage. In the vicinity of Jacksonville, where the solution passages are far below the level of the Atlantic Ocean, there are artesian heads of 50 ft. in 600-ft. wells, and of 60 ft. in 1,000-ft.

wells. Near New Smyrna and north of Tampa the rock surface is only slightly below sea level; in consequence there is a correspondingly low artesian head.

Near Jacksonville and St. Augustine the heads of water encountered at different depths have been recorded during the drilling of wells. Higher heads have been found in the lower water-bearing rocks than in the upper levels. The difference in heads corresponds very closely to 2.6 ft. for each 100-ft. difference in elevation between the two water-bearing strata. This condition suggests that the lower solution passages are approximately parallel to the upper, and discharge as much deeper in sea water as they are found in the well.

Only in a relatively small area of the high portion of the filter bed in the north central part of the peninsula does the head of fresh water in the underdrain system build up as high as 80 ft. above sea level. This pressure can depress sea water to an elevation 3,100 ft. below sea level. As the water flows from the intake areas toward the outlet, head is lost in friction and for every 2.6 ft. lost the sea water may rise 100 ft. Under these circumstances it is not surprising that all wells drilled for oil in Florida have encountered salt water at depths of 3,000 ft. or less. Much shallower wells near the coast yield salt water.

*Salt Under All Florida*—In view of the fact that the depth of limestone underlying Florida is known to be in excess of 3,000 ft., it is therefore evident that salt water exists in the voids of the rock under the entire peninsula and that it may be found at depths below sea level less than 38.5 times the fresh water head above sea level. Therefore, at any point where a well-water supply is established, care must be taken to maintain the groundwater level at sufficient elevation to keep the salt water depressed below the elevation of the bottom of the well. Salt water has but a short vertical distance to travel to enter a well. Unless there are other solution passages in which the head is high intervening between the salt water and the bottom of wells in a developed well field, salting of the supply may be expected when the head in the rock is reduced below a point above sea level equal to 2.6 ft. for each 100 ft. of depth below sea level.

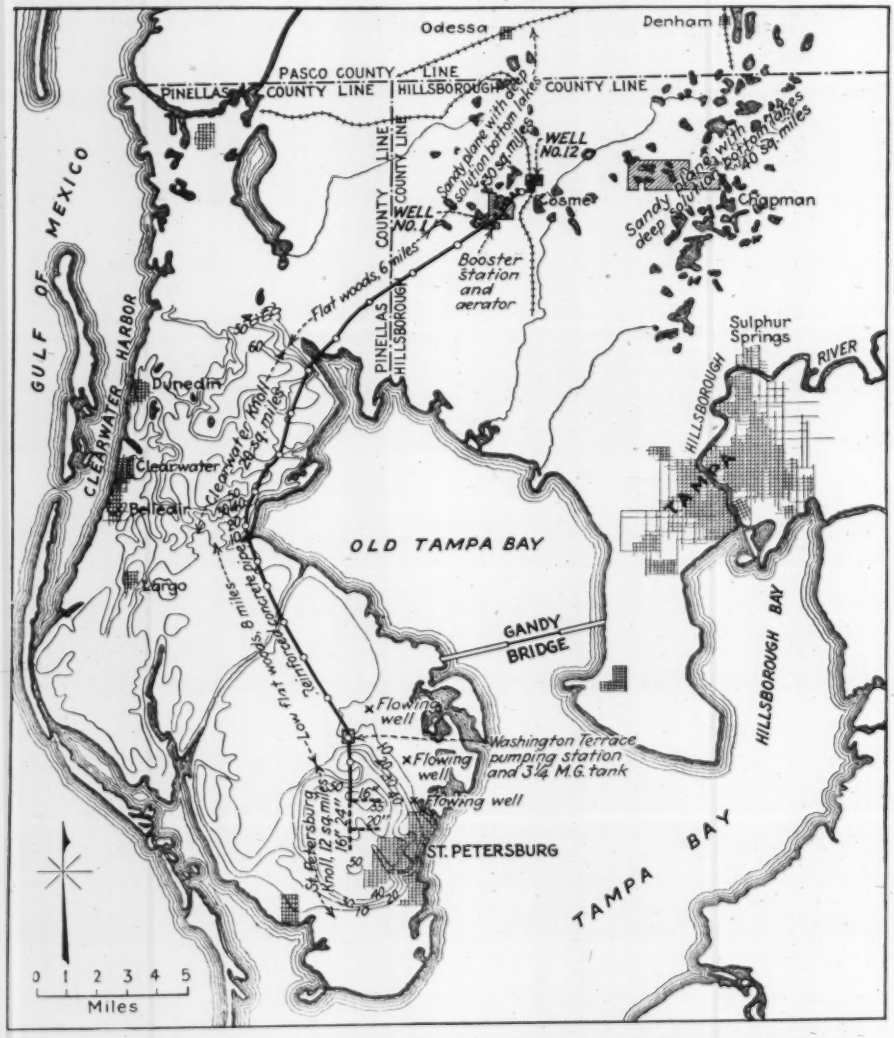



FIG. 2—GROUNDWATER POSSIBILITIES IN THE REGION OF ST. PETERSBURG, FLA.
The city is on the southeastern slope of a knoll more than 40 ft. above sea level. North for 8 miles is an area of low flat woods. Then for 10 miles is a knoll at the neck of the peninsula and more flat woods for 6 miles gradually rising to a sandy plane dotted with deep lakes, indicating a leaching-out of the bedrock, permitting sinks. This 30-square mile sink-hole area is duplicated 3 miles to the east by a larger cluster—40 square miles of sinks at an elevation 10 ft. higher.

*How Supply Was Ruined*—On a small scale the conditions for supply of fresh water from the overlying Tampa rock formation are similar to those of the deep Ocala rock. Fresh water is collected from the rainfall by the two sandy knolls on the Pinellas peninsula. This water passes downward into the Tampa rock and depresses the salt water level in the voids. The original wells under St. Petersburg found fresh water in wells penetrating the upper Tampa rock. Similar wells in Dunedin, Clearwater, Bellair and Largo have fresh water because of the collection of rainfall in the relatively high sandy knoll lying east of these towns.

Without doubt there were two causes leading to the salting of the St. Petersburg supply, the most obvious of which was the increased rate of draft from the wells to supply the growing city. However, coincident with this draft from the wells many miles of sewers were laid which reduced the groundwater level in the knoll. This had the double effect of reducing the percentage of the rainfall passing downward into the rock and reducing the fresh water head which had been effective in keeping the salt water depressed below the bottom of the wells. Other near-by sources

were unpromising. In the flat wooded area north of St. Petersburg, all wells show salt contamination when first pumped. The general level of the ground and groundwater is too low to expect much of the annual rainfall to reach the underlying rock. On the knoll lying east of Dunedin, Clearwater, Bellair and Largo, there are a number of small ponds marking the location where the underlying Tampa rock has been dissolved by constant downward flow of surface groundwater into it. Undoubtedly a series of wells properly distributed along the center of this knoll would yield a considerable supply of fresh water. Withdrawal of water from such wells, however, would soon reduce the supply to the existing wells which furnish water to the four Gulf coast towns.

*Lake Clusters Indicate Source*—The nearest adequate source of fresh water supply to St. Petersburg was found to be in the Cosme-Odessa lake region. This is an important source of water supply to the underlying Tampa rock and is similar in all respects to the Highlands lake region of central peninsular, Florida, supplying water to the underlying Ocala rock. The collection area in the Cosme-Odessa lake region is approximately 30 square miles. Assuming that only 40 per cent of the rainfall on the land area finds its way into the rock, the average daily supply of fresh water is 20 m.g.d. In order that this amount of groundwater may enter the rock it must filter down at an average rate of only 20 in. per year. The Denham-Chapman lake region lying east of the Cosme-Odessa area is a second important source of water supply to the Tampa rock, as witnessed by the large number of solution-bottom lakes. The size of this second area is 40 square miles and probably contributes one-third more water to the Tampa rock than is contributed by the Cosme-Odessa area.

With two such obvious sources of water supply within 3 miles of each other, there can be no doubt of the possibility of securing a supply adequate for the needs

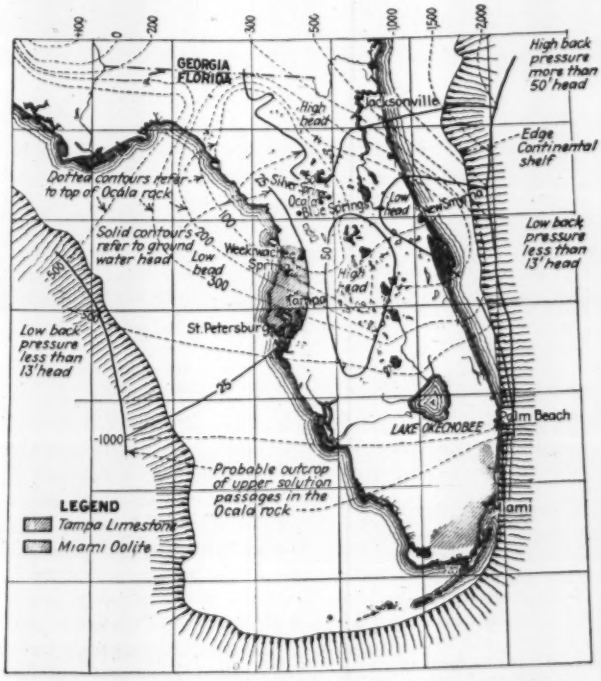



FIG. 3—CONTOURS OF OCALA ROCK UNDER FLORIDA AND PROBABLE OUTCROP IN FACE OF THE CONTINENTAL SHELF

Solid line contours show fresh water head in upper solution passages.

FIG. 4—SINK-HOLE NEAR WELL NO. 10 DEVELOPED AFTER PUMPING STARTED

of St. Petersburg from one or both of them. Groundwater level in the rock was found to be 40 ft. above sea level at Cosme and 50 ft. above sea level near Chapman. The head of water was therefore adequate to depress sea water to at least 1,500 ft. below sea level. Furthermore, it was considerably in excess of the head of water which probably exists in solution passages in the underlying Ocala rock.

*Precautions Taken*—The Cosme-Odessa lake region was therefore selected for the first development of the new St. Petersburg water supply. In drilling water-supply wells in this area, care was exercised to keep all of the wells in the upper rock formation. This was due to the assumption that the solution passages in the Ocala rock carry water from the Highlands region intake area in the central part of the state, and that they are large and discharge less than 500 ft. below sea level into the Gulf of Mexico. In these circumstances the head of water in the Ocala rock may be as low as 20 ft. above sea level at the well field. The water in the Ocala rock has also been in contact with the rock for a long period of time, as it flows a distance of 40 or 50 miles from the source to the outlets. It is, therefore, certain to contain more dissolved solids than water locally supplied to the upper rock formation. It is hoped that an average hardness of approximately 150 p.p.m. will be secured by continued pumping of the wells in the Cosme-Odessa area. To maintain this quality of water it will be advisable to limit the draw down of the Tampa rock water level to El. 25. A head of 25 ft. above sea level should be sufficient to prevent upward flow of Ocala rock water through crevices into the Tampa rock.

*Pumping Creates Sinks*—An interesting phenomenon took place at the first pumping of well 10, one of the twelve wells which have been drilled in the area. About 100 ft. from the well an area 20 ft. in diameter sank rapidly to a depth of 6 ft. below the original surface so that the groundwater formed a small pool in the bottom. A second sink dropped a portion of the county road and a third lowered the ballast from under the railroad tracks. No material had appeared in water discharged from the well. The ground has simply been disturbed enough by the unusual flow of water through it to start it running into crevices which had been dissolved in the rock over a long period of years. Similar sinks have been recorded in former years. Some have occurred and been repaired where the railroad traverses this lake area.

The twelve wells which have been drilled across the southerly end of the area vary in depth from 250 to 300 ft. These wells yield from ¾ to 2 m.g.d. each. Their combined yield is over 15 m.g.d. There is a 4-ft.

difference in static water level between the first and last wells, the head being from El. 37 at the southwest end of the line to El. 41 at the northeast end of the line 2½ miles away. Evidently this slope in the groundwater level rises in a northeasterly direction to the higher groundwater level in the Denman-Chapman area.

Samples of cuttings at 10-ft. intervals were furnished from all the wells to the state geologist. These showed that wells 7 and 8 each penetrated 10 ft. into the hard top rock of the Ocala formation. The upper part of these wells and the entire length of the other wells were in the upper and younger rock formation. The wells show the younger rock formation to have at this point a depth of approximately 240 ft. above the Ocala rock and a surface elevation close to sea level. On top of the Tampa rock is a depth varying from 60 to 100 ft. of fine sand containing lenses of clay.

Next to the elevation, extent and porosity of the intake areas, the most important factor in storing water in the voids of the rock is the back pressure of sea water upon outlets of the solution passages. This back pressure is in direct proportion to the depth of the outlets below sea level. If it were not for this greater weight of salt water producing the effect of a dam on the fresh water outlets, the fresh water entering the rock from the rainfall would rapidly seek sea level in the very large existing solution passages. The fresh water supply in the Ocala rock underlying Florida may therefore be considered as a great reservoir held within a salt water dam.

The Tampa formation from which the new supply for St. Petersburg will be drawn lies on top of the Ocala rock. Water which enters the Tampa rock may flow downward through vertical crevices into solution passages in the Ocala rocks, but the head available to cause flow in this direction is only the difference between the head existing in the Ocala solution passages and that built up in the Tampa rock openings from the rainfall caught in the sands above them. It is probable that the bulk of the water in the Tampa rock flows through solution passages parallel to the rock surface to outlets near or below sea level in the rivers, bays and gulf. Sulphur Spring, near Tampa Bay, and Weekiwachee Spring, west of Brooksville, are visible proof of this lateral flow in solution passages in the Tampa rock. As the head is reduced by pumping from the new well field, less water will flow to the natural outlets and a greater proportion of the rainfall will filter downward into the rock. Upon continued pumping the average time of contact of the water with the rock should be reduced, and a corresponding reduction in hardness is to be expected.

# Importance and Necessary Treatment of Groundwater Supplies

## Relatively Safer Than Surface Waters—More Groundwaters Should Be Softened, Since Improved Equipment and Modern Knowledge of the Use of Lime, Soda Ash Recarbonation, Zeolites, Aeration and Filtration Make This Possible at Low Cost

By Robert Spurr Weston
*Of Weston & Sampson, Consulting Engineers, Boston, Mass.*

FROM ANCIENT days the advantageous characteristics of groundwaters have been recognized. Generally, they are safer than surface supplies; usually they are colorless and clear; in cold weather, when distribution systems are in danger from freezing, they are warmer; and in summer, when baths and copious draughts of drinking water are in order, they are cooler. Apparently, however, groundwater supplies are more favored on the European continent than in the United States. Large cities like Berlin, Dresden, many Dutch cities, and parts of London and Paris are supplied with groundwater, while in the United States the cities so supplied—Memphis, Camden, Dayton, Elizabeth and Lowell, to cite a few—are relatively small. This difference in use is largely because the European cities are located where groundwater sources are abundant. The contrary is usually true in the United States.

While groundwater supplies are uncommon among United States cities of 100,000 or more population, they are not so among smaller cities and towns. Even in Massachusetts, which is characteristically an urban state with many upland sources available, there are 106 groundwater supplies and 90 surface supplies; in Illinois, 395 municipalities use groundwater and only 99 use surface-water supplies.

**In no branch of public water supply is there more backwardness than in the treatment of underground waters. It is not so much that the art and science lag behind as that our cities do not make use of knowledge, processes and apparatus already available. Underground water needs treatment, and the processes now available to meet the varying conditions are outlined in this article by Mr. Weston.**
***—Editor.***

### *Groundwater Characteristics*

Naturally, the rain, which falls on the earth and percolates through the soil until an impenetrable stratum is reached and thereafter flows toward the sea, dissolves more or less of the mineral matter from the soil and rocks with which it comes in contact on its course. This dissolved matter gives groundwaters many of the characteristics which, as a class, distinguish them from surface waters.

Groundwaters may contain both dissolved gases and dissolved solids; of the former, methane, hydrogen

sulphide and carbon dioxide are the most important. Methane, or marsh gas, is a combination of carbon and hydrogen and results from the decomposition of organic matter by bacteria in the absence of oxygen. Hydrogen sulphide, like methane (hydrogen carbide) is also a product of organic decomposition in the absence of oxygen, but in its formation the decomposition or oxidation process has been carried far enough for the bacteria to attack the sulphates, withdrawing the oxygen from them and leaving sulphides in place of sulphates. These sulphides are then decomposed by the acids of the soil, liberating the offensive hydrogen sulphide in gaseous form. Under certain conditions of pressure and temperature, one volume of water may dissolve 2.5 volumes of this gas. Fortunately, it is readily removed by aeration. Waters which contain it are known as sulphur waters.

Carbon dioxide is the most important gas in groundwater. When the aerated rainwater begins to work into the earth, it is nearly saturated with oxygen and contains little carbon dioxide. As the aerated water percolates through the soil it loses its oxygen to the bacteria which are oxidizing the organic matter and becomes charged with carbon dioxide which the bacteria produce. Sometimes the amount of carbon dioxide dissolved under pressure is enough to give a sparkling appearance to the groundwater when drawn. One volume of water will dissolve about one volume of carbon dioxide and the gas so dissolved is called carbonic acid. This is a ready solvent for certain substances; for example, pure water will dissolve about 20 p.p.m. of calcium carbonate (limestone) and about 28 p.p.m. of magnesium carbonate (dolomite), while water charged with carbon dioxide will dissolve many hundred parts per million of these carbonates.

Carbon dioxide will also dissolve iron from deposits of bog-iron or other iron ores or from rocks containing iron. Waters containing dissolved iron are usually clear when first drawn, but when exposed to the air the oxygen rapidly displaces the carbon dioxide, the water clouds and the iron oxide coagulates and precipitates, leaving above the clear water, practically free from iron.

Certain substances like the sulphates, chlorides and nitrates of calcium and magnesium which make up the mineral acid hardness of water—the so-called permanent hardness—are dissolved from soil and rocks without the aid of carbon dioxide. Certain other substances—the so-called alkaline and saline constituents—are also so dissolved.

To rid water of methane, hydrogen sulphide or carbon dioxide by aeration is an easy matter, but to remove carbonic acid combined with calcium, magnesium and iron is more difficult. In some cases aeration will accomplish the desired end, but usually further treatment is required.

### *Lime for Carbonate Hardness*

For the removal of carbonate hardness, the so-called Clark process has been in use for over a hundred years. In simplest terms it consists in adding enough calcium hydrate (hydrated lime) to a hard water to combine with the free carbon dioxide and to change the soluble calcium bicarbonate into the relatively insoluble carbonate (chalk) and the soluble magnesium carbonate into the relatively insoluble magnesium hydrate. The insoluble precipitate caused by the application of the softening chemicals is removed by subsidence and filtration.

The original Clark process reduces the carbonate hardness in a water to from 60 to 100 p.p.m., although in practice the higher result is more common than the lower. Water, so softened, would be called hard in cities like Boston and New York, which are supplied with water having hardnesses of less than 20 p.p.m.; they are not entirely satisfactory even in the hard water regions of the West. Fortunately, through the work of C. P. Hoover and others, this softening process has been improved so that the hardness of the treated water may be reduced to nearly 30 p.p.m., or to about the theoretical solubilities of the earthy carbonates in water.

While calcium hydrate, or its dry equivalent (quicklime) is the cheapest reagent for softening water, it has no effect on the mineral-acid hardness, such as that

PLANT FOR IRON REMOVAL AT AMESBURY, MASS.

produced by calcium sulphate (gypsum). Mineral-acid hardness is the most feared by boiler users, because it forms a hard scale on the heating surfaces; consequently, its removal is more important than the removal of the carbonate hardness.

### *Treatment for Mineral-Acid Hardness*

Shortly after the coming into use of the Clark process, one Porter in England added sodium carbonate (soda ash) to lime for the purpose of precipitating the mineral-acid hardness not removed by the Clark process. The sodium carbonate acts on the sodium and magnesium chlorides and nitrates, which it changes to carbonates, which are then removed in turn by the lime treatment, leaving in the water sulphates, chlorides and nitrates of sodium, which are readily soluble and do not affect the hardness of the water.

The Porter-Clark process is simple in theory but often difficult to carry out in practice. In the first place, the rate of formation of the precipitate is often slow, and the precipitated particles may be small in size and difficult to remove by subsidence or by filtration. Again, the carbonates tend to crystallize on the sand grains of filters used to clarify the water, thereby enlarging them and diminishing the effectiveness of the filters. Furthermore, chalky deposits may form in service pipes and in meters. These difficulties are now largely overcome by over treatment with calcium hydrate, with recarbonation of the over treated water, with better coagulation and crystallization of the chalky precipitate formed.

Over treatment with calcium hydrate greatly accelerates coagulation and precipitation, but it produces a water which has a high caustic alkalinity and is unsuitable for distribution. The remedy used for this

disability is recarbonation, using carbon dioxide gas, which is usually prepared by the combustion of coke in a gas producer. The gases from the producer contain perhaps 15 per cent of carbon dioxide. They are scrubbed to remove impurities and then added to the water through pipes and diffusers as it flows through the treatment plant and before filtration. Water treated with carbon dioxide will not form accumulations on filter sand or in the distribution system, and also it is of better appearance than water produced without its use.

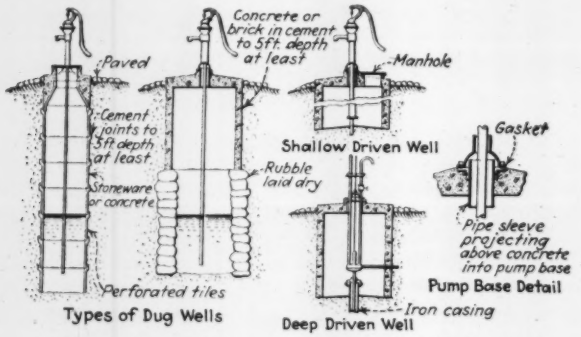
### *Precipitation Principles*

In the softening process, the coagulation and precipitation of the chalky deposits is a physico chemical action. Time is required for the formation of the chalky crystals, to be removed later by filtration. When the plants are provided with basins of large capacities, these results may sometimes be accomplished by plain subsidence alone, but it is expedient to hasten and improve the process through treatment by various devices.

Every chemist who makes a precipitation knows that intimate mixing is an essential and that slow stirring promotes coagulation and crystallization. Furthermore, stirring increases the sizes of the precipitated particles. Also, the presence of the precipitated mass itself accelerates the process.

In practice these principles are used with good effect. In the first place, the chemicals are mixed with the waters by violent agitation for a short period; then follows a period of stirring or slow movement in channels or circular tanks, motion to the water in the latter being imparted by tangential inlets or slowly moving stirrers.

To secure the good effect of mass, some of the settled chalky deposits from the basins are pumped back into




TYPES OF WELLS SHOWING GOOD POLLUTION PROOF DESIGN

other inlets. This practice greatly promotes the clarification of the treated water.

As the treated water goes to the filters, it may carry with it some turbidity as a result of imperfect subsidence, in spite of over treatment with calcium hydrate and recarbonation. To remove this turbidity the coagulants ordinarily used in water purification are applied. In this connection, sodium aluminate is often useful, although iron sulphate or sulphate of alumina are used most frequently, sometimes in combination with sodium aluminate.

For the complete softening of water the zeolite process is the only one available. Zeolites are bodies which possess the property of exchanging non-hardening constituents for the hardening constituents in water. They act in a cycle. They have a limited capacity which is restored by regeneration of the zeolite by treatment with ordinary brine. Because the period of treatment is far shorter than the period of softening, the use of zeolites is practicable.

Zeolites must be supplied with clear water free from matters like iron which would occlude the zeolite and obscure its action. Both natural zeolites, made from glauconite, and artificial zeolites, which are complex silicates formed by precipitation and chemical treatment, are in use. Artificial zeolites are more efficient bulk for bulk and are also more costly than the natural ones. Where the hardness of water is less than 200 p.p.m. zeolite plants cost from $15,000 to $25,000 per million gallons of daily capacity.

While the use of a zeolite softener is not often advisable for the removal of carbonate hardness, the choice between it and the Porter-Clark process for the removal of mineral-acid hardness is frequently determined by the relative costs of salt for the regeneration of the one and of soda ash for use in the other. The zeolite softeners are usually simpler to operate than other kinds, but require clear water and where hardnesses of water are high may exchange so much sodium carbonate for the hardening constituents that the treated water will be too alkaline.

Combinations of the lime and zeolite treatments are often advantageous, especially when the hardness is largely due to carbonates. The treatment with lime (calcium hydrate) removes the bulk of the hardness at low cost. Later the clear and largely softened water is passed through zeolite to remove the mineral-acid hardness with less cost for chemicals and much less danger of producting a highly alkaline effluent than if the zeolite process alone were used.

At Sewickley, Pa., the final treatment with zeolite is made in mechanical filters using a natural zeolite in place of the usual filter sand, thus effecting clarification and chemical exchange in one device.

The economics of water softening are just beginning to be appreciated. Probably not over 10 per cent of the waters which should be are softened. So unfortunate is this condition that the formation of an association for the enlightenment of users of hard waters has been proposed. That water softening in most American municipalities supplied with hard waters has been too long postponed is evident from the fact that in most cases the saving in soap alone would pay for softening. In addition there would be savings to users of boilers and hot water heating systems, to bleachers and dyers, and to manufacturers and others.

### *Iron Removal*

Iron, although not so important a cause of monetary loss as hardness, is a troublesome constituent of groundwater. When present, it causes deposits of rust in pipes and reddish stains on plumbing fixtures and washed fabrics. While its presence is probably not unhealthful, it causes much inconvenience and damage. One characteristic of a water containing iron is the tendency for the iron content to increase with use. Many wells which yielded iron-free water when first sunk are now high in iron.

Manganese, a near relative of iron, is often associated with it, but usually in lesser amounts. Manganese is dissolved from manganiferous deposits, rocks and ores. Like iron, its presence in freshly drawn groundwater is noted by a styptic or inky taste. It oxidizes or rusts like iron, but more slowly, and produces black instead of reddish deposits and stains.

The permissible limit of iron in a groundwater is from 0.2 to 1 p.p.m., depending upon the other salts dissolved with it. Soft waters, low in organic matter, will hold less iron in solution than "peaty," saline or hard waters. When hard waters are softened with lime, any iron or manganese is removed in the process.

Like the Porter-Clark process, deferrization, or iron removal, is simple in principle but often difficult in practice. It consists in displacing the solvent carbon dioxide by aeration, the formation of insoluble iron hydrate or rust by oxidation and coagulation, and the straining out of the suspended hydrate by filtration.

The removal of carbon dioxide is usually easily accomplished, but sometimes compounds of organic matter and iron resist oxidation, or else resistant bicarbonates are present. Sometimes iron sulphate is present. The period of oxidation is then prolonged and the benefits of contact with already precipitated iron are made available by the use of tricklers, or rieselers. These are essentially beds of coarse coke from 2 to 12 ft. in depth, through which the aerated water is made to pass in contact with the previously oxidized iron hydrate which has accumulated on the surfaces of the coke particles. Sometimes tricklers are in the form of superimposed coke-filled trays. These tricklers, or rieselers, are freed from excessive accumulations of iron hydrate by washing in place with hydraulic jets, by flushing at increased rates, or by filling with water and emptying suddenly. In some cases the coke is removed, washed and replaced periodically. While cleaning is necessary, an accumulation of hydrate is equally necessary, and the tricklers may be allowed to become too clogged for efficient exchange of gases by aeration, or be cleaned too thoroughly for efficient contact action.

Either slow or rapid filters may be used for removing the last traces of precipitated iron, but because of the high rates (10 m.g.d. or more) which may be employed, the former are frequently more economical, and in most cases give better results. The following typical set of results of operation of the deferrization plant at Amesbury, Mass., illustrates the process. This plant consists of coke tricklers, subsiding basins, slow filters and appurtenances. The results of its operation indicate complete aeration, good removal of carbon dioxide and the removal of 99 per cent of the iron.

| | Oxygen | | Carbon | |
|---|---|---|---|---|
| Source of Sample | p.p.m. | Per Cent Saturation | Dioxide, p.p.m. | Iron, p.p.m. |
| Wells | 0.4 | 4.2 | 31 | 4.4 |
| Aerator effluent | 4.9 | 42.2 | 17.5 | 5.1 |
| Trickler effluent | 12.6 | 108.5 | 10 | 3.3 |
| Basin effluent | 12.8 | 110.2 | 9 | 3.1 |
| Filter effluent | 12.4 | 106.6 | 7 | 0.05 |
| Tap in pumping station | 12.4 | 110.6 | 6 | 0.05 |

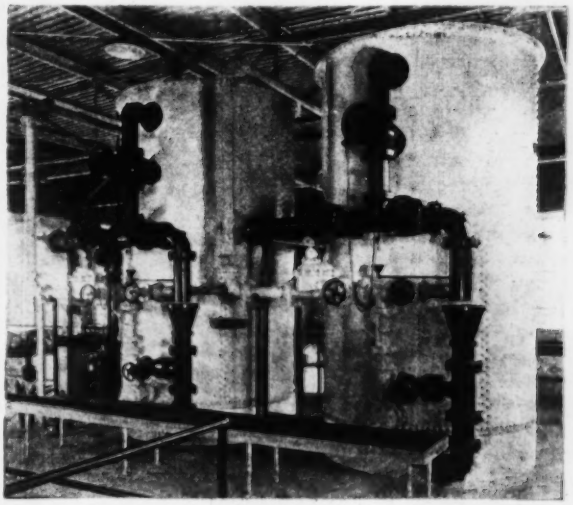
Where the iron oxidizes readily, sand filters may sometimes be omitted and filters of fine gravel be depended upon. On Long Island, Malcolm Pirnie has employed upward filtration successfully. Upward filters present many advantages and where applicable are more economical.

Sometimes coagulation is so difficult that treatment with chemical coagulants must be employed. In these cases rapid filters, cleaned by washing, are indicated.

### *Precautions for Safe Groundwater*

One reason for using groundwaters is because they are relatively safer than surface-water supplies. On the average, as extensive studies of the Illinois water surveys show, they are the safer the deeper they are drawn from the earth. Deep wells in rock may be excellent when drawn from seams in granite, gneiss or sandstone; or dangerous when drawn from cavernous limestone through which pollution may travel rapidly. Into many of these caverns which connect with sources of water supplies, well holes have been driven to receive sewage. This practice cannot be too strongly condemned. Wells in deep rock which are otherwise excellent may be polluted where an insufficient cover of soil allows surface water to reach the well, or where defective casings admit pollution from near-by sources. Special attention should be given to the choice of metals for well casings, lest the water become corroded unduly and cause leakage with consequent pollution.

Shallow wells in gravel should be placed with care and with many of the precautions which are taken when selecting surface sources. While good water may often be drawn from gravel beneath polluted rivers, all shallow well supplies should be carefully tested for a considerable period before use and watched while in service to guard against changed conditions.



ZEOLITE SOFTENERS IN NEW PLANT AT SPRINGDALE, PA.

The protection of well supplies is a necessary part of their construction. Casings and curbs should be tight and where the former enter rock they should be carefully sealed. Care should also be taken to exclude surface water from the well heads, and the covering of large wells is imperative. Some of the methods of construction of small wells are shown on the preceding page.

A higher bacteriological standard of quality should be set for ground than for surface water. There should be no question about its conforming with the revised U. S. Treasury standard for waters used in interstate commerce. Sometimes, however, gas-forming organisms, which are usually indicative of bad quality when found in a shallow well water, may be found in deep well waters from impeccable sources. These organisms may possibly be derived from fossilized deposits which are insignificant from a sanitary standpoint.

In conclusion one may state that groundwaters are usually agreeable and safe sources of water supply which, where abundant, ought to be given consideration over surface supplies in most cases. The usual disadvantages—namely, hardness and presence of iron—may be overcome by treatment at relatively low cost.

# Hard Muddy River Water Treated *In New Purification Plant at Saginaw, Mich.*

**Preliminary Treatment Includes Two-Stage Mixing and Two-Stage Sedimentation—Special Architectural Development Required Because of Park Location**

**Some of the many things water-treatment plants are called upon to do nowadays and the ingenious means by which the requirements are met are shown by this article on the Saginaw plant. The layout also exemplifies modern trends in designing such plants to harmonize with their natural surroundings. More unusual facts brought out by the article are those briefly summarizing a 25-year struggle to get an improved supply. Part of the delay resulted from the fallacy of submitting plan after plan to popular vote for approval. Factional conflicts, in some of which commercial interests apparently took part, also added to the troubles of those working for a better water supply. Consequently, remarkable as the plant is technically, its history is a useful commentary on engineering in politics and politics in engineering.** —*Editor.*

FLEXIBILITY and dependability of operation have been achieved in a remarkable degree in the new water-purification plant at Saginaw, Mich., and great care has been taken to bring the appearance of the buildings, which are located in the city park, into harmony with their surroundings.

Dissatisfaction with the quality of the untreated Saginaw River water developed more than 25 years ago. The first attempt to secure the voters' approval of a bond issue to pay for a filtration plant was made in 1906 and was defeated by almost 5 to 2. In all, twelve different elections were required before the necessary three-fifths majority was obtained in favor of the project as finally carried out. There had always been a simple majority in favor of the issues proposed, but differences of opinion as to the most advisable source to be selected led time after time to their ultimate defeat. The sources considered were the Saginaw River, Saginaw Bay, the Shiawasee River, and the groundwater field in the vicinity of Claire, Mich. Finally, in 1924, the voters were given an opportunity to express their approval of a bond issue to pay for a pure water system and at the same time give their preference as to source. The issue was carried and a majority of the voters were in favor of obtaining water from wells to be sunk in the Claire region, even though the cost of that project was estimated to be far greater than any of the others. Engineering investigations of the region made after the election, however, led to the conclusion that adequate supply from that source could not be assured. Accordingly, the city administration prepared for another election at which the choice of source should be confined to the three others. An attempt was made at this point to enjoin the city from proceeding with the election plans on the ground that the former vote had been mandatory rather than advisory, but the court held with the city council and the election was held. The Saginaw River was chosen as the preferred location on Feb. 8, 1926, and the city was enabled to carry out its plans for the design and construction of the new plant.

The new supply, drawn from the river by an intake in the Lake Linton bayou, is now settled with the aid of coagulants, softened, recarbonated, filtered and chlor-

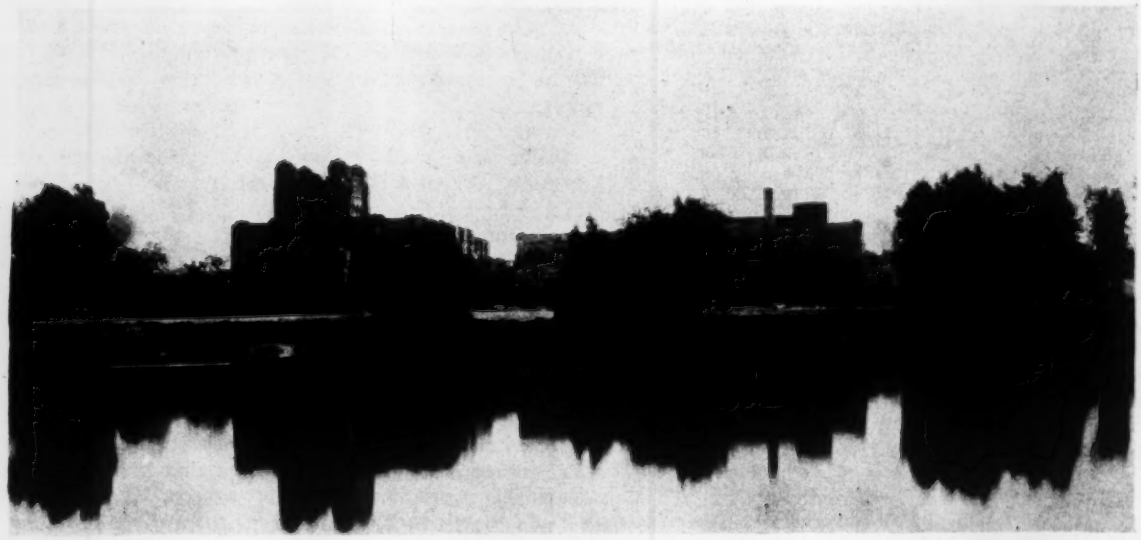


FIG. 1—PURIFICATION PLANT IN EZRA RUST PARK, SAGINAW, MICH.
Looking across Lake Linton, in which the sumberged intake is located. The screen room, engine room and wash-water tower are at the left. Chemical treatment processes are in the building at the right.

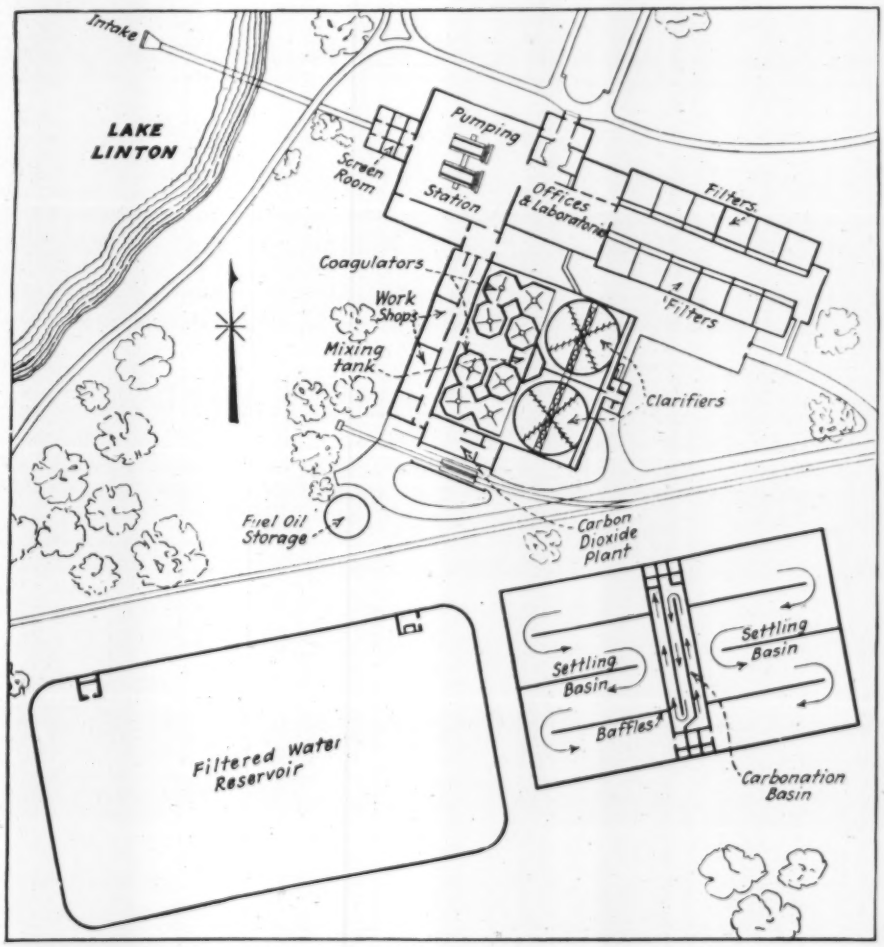



FIG. 2—GENERAL PLAN OF SAGINAW, MICH., WATER-PURIFICATION PLANT

inated in a plant with a normal daily capacity of 25,000,000 gal. (25 m.g.d.). Provisions for feeding the coagulating and softening chemicals have been made so flexible that softening may be effected by a variety of methods or combinations of methods. Plant and equipment layout has been so arranged that it is possible to eliminate or bypass any one of the various plant units without impairing the mechanical operation of the plant. The mixing of chemicals and water and the subsequent reaction and flocculation proceed in separate sets of concrete tanks, each equipped with mechanical agitators. Two-stage sedimentation, with continuous sludge removal in one stage, precedes the carbonation. Carbon dioxide, for use in the latter process, is manufactured in the plant by burning the gas produced by the destructive distillation of coke. Electric power service for the pumping station is really in triplicate, as there is a central station supply with connection to two substations, and a diesel engine installation for stand-by service.

The plant is located on the shore of Lake Linton in Ezra Rust Park. Because of these attractive surroundings, the buildings were built in Gothic style; the group is dominated by a turreted square tower 85 ft. high. In keeping with the general architectural design, the building material is a special slag brick of gray stone color, developed by a local manufacturer.

Having its invert 12 ft. below the lowest recorded stage of the Saginaw River, the plant's intake rests on the bottom of the Lake Linton bayou, with the connecting channel newly dredged clean of mud and silt. The intake itself is a concrete box having an opening of 60 sq.ft. protected by a grating of cast-iron bars, spaced 13 in. c. to c. A 60 x 65-in. reinforced-concrete conduit conveys the water from the intake to the screen chamber, where three parallel channels are provided, two of which are at present equipped with traveling screens. These screens are of the endless belt type and are cleaned by water under pressure. A 54-in. pipe collects the water from the screen chambers and connects with the 48-in. suction header of the low-lift pumps.

There are five low-service pumps—two of 8,750 g.p.m. capacity, and three others of 7,280-, 5,810- and 4,375-g.p.m. (12.6, 10.5, 8.4 and 6.3 m.g.d.) respectively, operating against a total head of 34 ft., all of them motor-driven centrifugal pumps. They are arranged in a single line along the screen room end of the pump room. For dependability of service the discharge header is in the form of a loop, one section carried on the pump room floor and the other on the basement floor immediately below, so valved that no single repair to pumps, piping or valves would throw out of service more than two of the five pumps.

*Chemical Treatment*—From the low-service pumps the water is delivered to the chemical building, and there rises in a well located between the two mixing tanks. Into the water as it rises in this well are fed the coagulating and softening chemicals by means of dry-feed

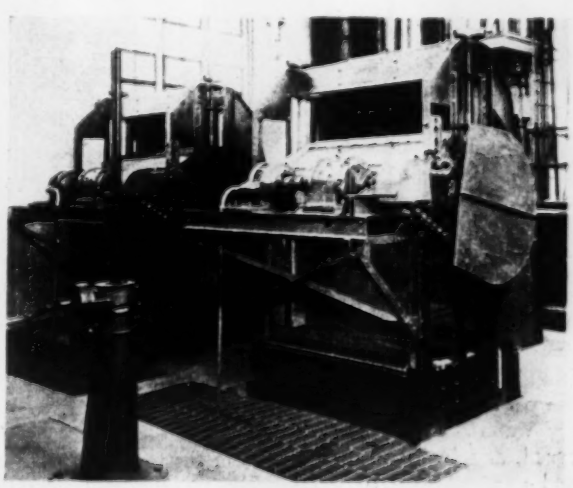


FIG. 3—TRAVELING SCREENS PROTECT LOW-SERVICE PUMPS

machines. Six machines are provided for this purpose, two each for quicklime, soda ash and alum. All are equipped with scales by which the net weights of chemicals in the hoppers are indicated upon large dials mounted upon the floor. The machines handling the lime continuously slake the material as it is fed into the water. The chemical feed apparatus and flow arrangements are such that softening may be carried on by the ordinary lime and soda ash methods, by the excess lime method, by the split-treatment method or by any practicable combination of these that may be desired.

The equipment for obtaining a thorough mixing of the water and the chemicals fed into it consists of a pair of rectangular concrete tanks, through which the water flows in an upward direction, being agitated at the same time by paddles rotating on a vertical shaft. The sizes of these tanks are such as to allow a mixing period of about two minutes when the plant is operating at its normal 25-m.g.d. rate.

*Reaction Tanks*—Two batteries of octagonal reaction tanks of four units each, one battery on each side of the mixing tanks, allow a one-hour period for the chemical reactions and flocculation to take place. This process is facilitated by gentle agitation provided by paddles similar to those in the mixing tanks but rotating at a much slower speed. The stirring has the additional purpose of preventing the settling of the precipitates before the clarifiers are reached. The tanks are 28 ft. in short diameter, 28 ft. deep at the sides and 33 ft. in the middle, the bottom being cone-shaped.

An unusual detail in the design of the paddle drive is the "shock absorber" provided in the transmission at the top of the vertical shaft. The drive gear is connected to the shaft by means of heavy coiled springs designed to allow for the inertia of the body of water in the tank at

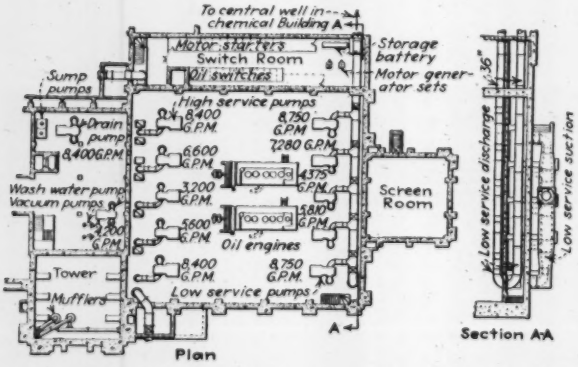



FIG. 4—ENGINE ROOM AND ARRANGEMENT OF EQUIPMENT

Both low- and high-service pumps discharge into looped header to permit maximum dependability.

times of starting the paddles. It can be plainly seen in Fig. 5.

This step in the power transmission permits the motor to come up to its normal speed under a light load, as the paddles rotate slowly at the start and practically the only load on the motor is that required to wind up the spring. As the spring becomes wound tighter this load increases, the motor storing up energy in the spring faster than it is expended in driving the paddles. The acceleration of the paddles occasions more and more force to overcome the water's resistance, until they are operating at full speed, at which time the spring is tightened no further and the full load of driving the paddles through still water is upon the motor. It has been observed that in operation the worm gear driving the spring makes about one-fourth revolution before the paddles attain an operating speed of one revolution in 50 seconds. The starting load on the motor has been found to be very light, and even at high speeds of operation there is no evidence of laboring or distress in the drive mechanism.

Initial settling of the chemical precipitates and coagulated turbidity is accomplished in two concrete clarifying basins, each 64 ft. square and 17 ft. deep, allowing a 50-minute retention period. The bottoms of these tanks are circular in plan and are equipped with continuous sludge-removal apparatus.

*Carbonation*—The partly settled water leaving the clarifiers is led by underground conduits to the large

FIG. 5—CHEMICAL FEED APPARATUS WITH DRIVE FOR COAGULATION-TANK AGITATOR SHOWN IN FOREGROUND

Note the coils of shock absorber on vertical shaft of agitator. Other equipment as follows: *A*, lime-feeding machines with hydrating trough at bottom; *B*, soda ash feeders; *C*, aluminum sulphate feeders.

settling basins on the far side of the railroad tracks that cross the park. Two concrete basins, each 164 ft. long by 122 ft. wide and 21 ft. deep, have a total capacity of 6 m.g. and, therefore, allow a settling period of six hours under normal conditions of flow. The two units are placed side by side, separated only by the relatively narrow carbonation basin into which the settled water discharges. The length of this latter chamber is equal to the width of the settling basins, 126 ft.; its width is 26 ft., divided by longitudinal baffles into three channels, and its depth 21 ft. The water remains in the chamber about 30 minutes, during which carbon dioxide is allowed to bubble up through it from a grid of perforated pipes on the bottom. This gas reacts with any excess lime that may be in the water at this stage of its treatment, preventing the deposit of calcium carbonate in pipes or valves farther on in the system, and in addition adding a certain amount of life or sparkle to the water.

Carbon dioxide gas for this last process is manufactured in the plant. Coke gas is prepared by the distillation of coke in an ordinary gas producer, and is then burned in a furnace beneath a boiler under conditions in which the air supply is carefully controlled. The tar, sulphur and other impurities in the furnace flue-gases are removed by a scrubber, and the remainder, consisting mostly of nitrogen and carbon dioxide, is compressed and delivered to the carbonation basin. The plant is designed to deliver an 18 per cent gas mixture in which the carbon dioxide content amounts to 7,500 lb. per day.

*Filters*—Returning to the main group of buildings, the settled and carbonated water enters the filter house, where it is distributed among twelve rapid filters, placed

six on each side of a central operating gallery. Each filter is 28x26 ft. in plan, and at a normal operating rate of 125 m.g.d. per acre has a capacity of $2\frac{1}{2}$ m.g.d. Water head on these filters is rather high, between 6 and 7 ft., resulting in a reduced tendency to form negative head or suction in the sand bed. The sand bed itself consists of 30 in. of sand having an effective size of 0.45 mm. and a uniformity coefficient of not more than 1.5. Supporting this filtering material is an 18-in. bed of gravel graded in size from material retained on a 10-mesh sieve at the top to that passing a 2-in. mesh at the bottom. The collector system beneath the gravel consists of perforated cast-iron pipe laterals, $2\frac{1}{2}$ in. in diameter, provided with $\frac{3}{8}$-in. brass-bushed orifices spaced on $5\frac{1}{8}$-in. centers. The laterals themselves are laid on $8\frac{1}{8}$-in. centers. They discharge into tapered cast-iron manifolds, 5 in. wide at their outer ends, 12 in. wide at the center of the filter and 5 in. high throughout their length. The total depth of the concrete filter box is 13 ft. Four steel troughs in each filter, spaced $6\frac{1}{2}$ ft. apart, with weir edges 24 in. above the sand, provide for the removal of wash water.

Located in the tower already mentioned is a 125,000-gal. steel wash-water tank. It is planned that filter washing shall be at a rate of 24 in. per minute vertical rise, but the elevation of the tank and the arrangement of the piping will permit greater rates than this should they ever be desired. While the plant was being tuned up preparatory to being put into operation, a study was made of the behavior of the filters during washing. After they had been washed thoroughly to remove a small amount of fine sand, it was found that a wash rate of $23\frac{1}{2}$ in. per minute could be used without losing an appreciable amount of sand and that this rate appeared to be the highest necessary to apply. To obtain uniformity and to prevent the use of excessive wash rates by the operators, rate controllers are placed in the supply line. The tank is filled by means of an independent pumping unit, of 4,200-g.p.m. capacity, drawing water from the clear well.

FIG. 7—OPERATING GALLERY WITH HIGH FILTER WALLS

Special architectural treatment given because this portion of plant is most frequented by park visitors. Large gages indicate wash-water rate (left) and elevation of water in tank (right).

In the 20-ft. wide pipe gallery between the filters a large amount of side and head room has been provided The floor is at an elevation 8 ft. lower than that of the bottom of the filters. A 30-in. cast-iron wash-water line is suspended from the ceiling, with the filter influent line, varying in size from 36 to 24 in., directly beneath it. The 30-in. drain line is buried beneath the gallery floor. Rate controllers discharge through the gallery wall into small reservoirs beneath the filter boxes, from which water may be delivered either directly to the suctions of the high-service pumps, or through an underground pipe line to the filtered water reservoir.

*Chlorination*—Normal operation calls for the application of chlorine to the water as it passes from the filter to the reservoir, but under emergency conditions it may be applied to the settled and carbonated water just prior to filtration, to the partly settled water leaving the clarifiers, to the raw water, or to the finished product just before it is actually pumped into the mains.

The floor of the filter-operating gallery is placed much lower than usual with respect to the level of the water on the filters, so that the top of the operating tables are flush with the top of the filter walls. A black marble finish is used on the sides and tops of tables and walls. An imitation stone is used to cover the concrete arches over the gallery. The ceiling is painted to give a dark antique effect.

A covered filtered-water reservoir of 9.2 m.g. capacity is located adjacent to the settling basins on the far side of the track. Small gate houses, designed to harmonize in appearance with the main buildings, are built over the influent and overflow openings.

*High-Service Pumps*—A second set of motor-driven centrifugal pumps is used to force the water under pres-

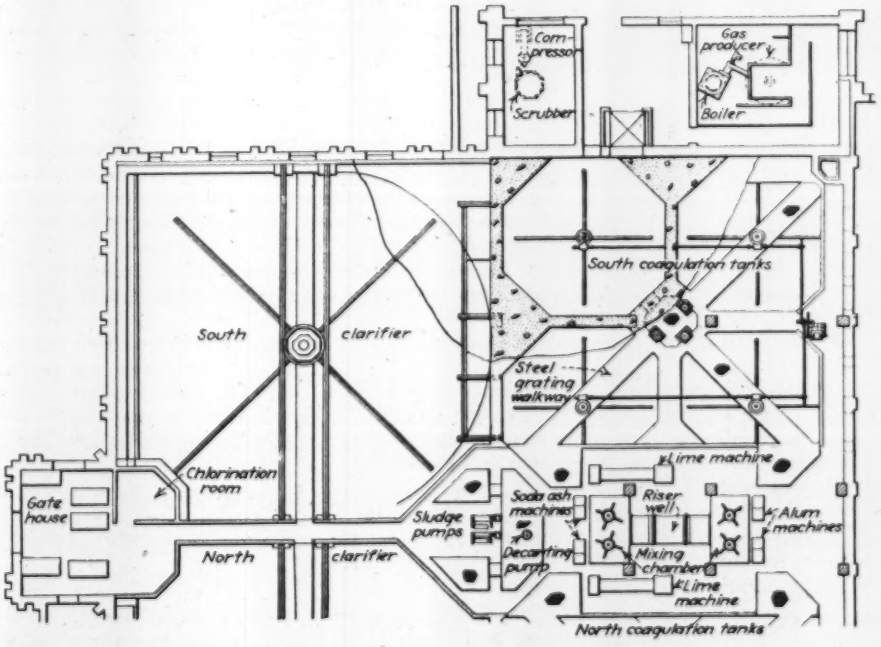



FIG. 6—OPERATING FLOOR OF CHEMICAL BUILDING

sure into the city mains. There are two pumps of 12-m.g.d. capacity and one each of 9.5-, 8.0- and 4.6-m.g.d. capacity, operating against a total head of 175 ft. The header into which these pumps discharge is connected at each end to supply mains which are cross-connected a short distance from the plant, so that a complete loop is formed. The arrangement of valves and piping gives the same degree of flexibility and dependability of operation as is achieved with the group of low-service pumps. Motor-operated valves are installed on the discharge pipes of the high-service pumps and

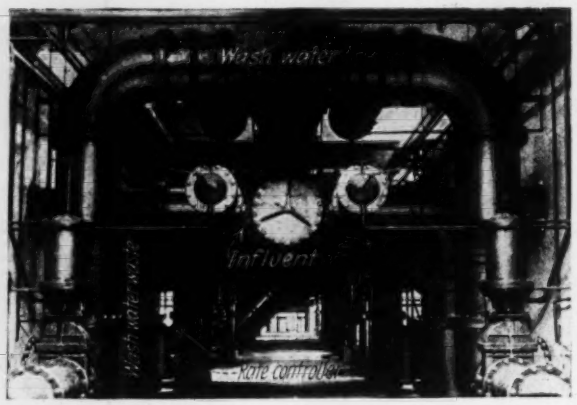



FIG. 8—PIPE GALLERY FLOOR LOWER THAN FILTER BOTTOM

the pushbuttons for their control are all located on a single panel of the main switchboard. This panel has laid out upon it a pipe diagram on which the controls for the various valves are spotted at the same relative positions that the valves occupy in the piping system. Such an arrangement reduces to a minimum the likelihood of an operator's opening or closing the wrong valve.

Power for the operation of the plant is purchased from a central station, coming from either of two local substations. As an additional safety factor, two diesel engines, driving 671-kva. generators, provide stand-by service. The engines are of the 8-cylinder, 4-cycle, air-injection type, and are placed side by side between the two rows of centrifugal pumps. Fuel oil is supplied from small service tanks located in the screen room at an elevation higher than the engines. These small tanks are filled from a large concrete underground storage reservoir by means of motor-driven fuel pumps. A gage board, installed between the two engines, has mounted on it a pyrometer for ascertaining the temperature of each cylinder exhaust on either engine, and two long-distance recording-level gages to show the quantity of fuel oil in each of the supply tanks. A switch is mounted on the board for controlling the motors of the fuel pumps.

*Silencer*—The exhaust from each engine is carried through a 14-in. cast-iron pipe to the basement under the tower and is there connected to a large muffler. The gases leaving the muffler pass through a 14-in. vertical uptake pipe to the top of the tower roof. These mufflers are entirely effective in silencing any noise from the engine exhausts. Tests indicate that there is practically no back pressure, although the exhaust piping is unusually long.

A 12-m.g.d. drain pump is located on the floor of the engine room, and is used to dewater the small reservoirs under the filters of the large clear well, or to remove water from the engine-room basement in case of any break in the piping. The pumps in the engine room are supported by heavy beams under the floor, thereby avoiding the use of foundations extending to the basement of the pipe room below and allowing freer access for purposes of maintenance and operation.

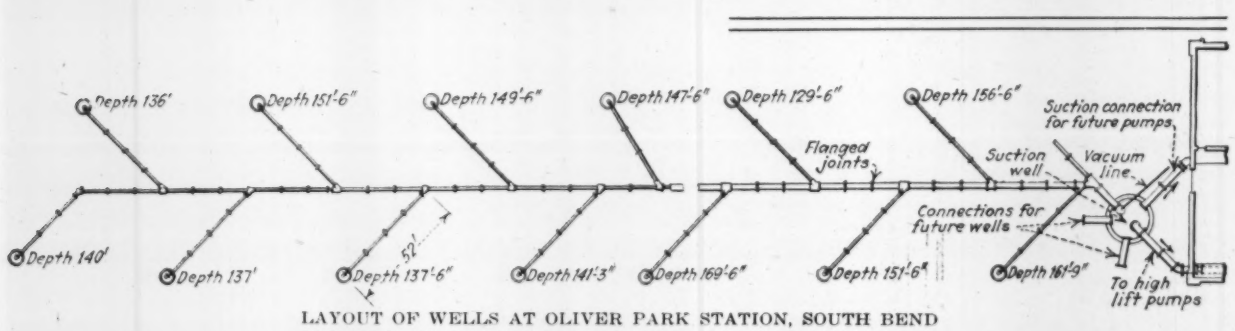
The design and construction of Saginaw's new plant was the responsibility of Herman H. Eymer, city engineer. The firms of Hoad, Decker, Shoecraft & Drury, of Ann Arbor, Mich., and Maury & Gordon, now Gordon & Bulot, of Chicago, Ill., acted as consulting engineers. V. A. Matteson, of Chicago, was the consulting architect. The F. R. Patterson Construction Co. was the general contractor.

# Well Development by Siphons at South Bend

## High Elevation of Gathering Area Brings Water Table Close to Surface—Clay Blanket Prevents Pollution From Surface

IN SUPPLYING water to the city of South Bend, Ind., advantage is taken of the high elevation of the water table to make use of the siphon principle in conveying the underground water from the individual wells to the suction chambers of the high-lift pumps. The presence of a thick layer of water-bearing sand directly beneath the city, with an extensive gathering area on adjacent higher ground, makes available an abundant supply of groundwater for the city's uses. Pollution by surface drainage, including the highly polluted St. Joseph River, is prevented from reaching the underflow by a heavy clay blanket overlying the sand beneath the city itself.

The siphon principle in developing groundwater supplies has not been used very extensively in this country.




LAYOUT OF WELLS AT OLIVER PARK STATION, SOUTH BEND
Siphon principle used to convey water from wells to pump suction well.

although there are numerous examples of its use in Europe. With the static level of the water in the wells at South Bend not more than 10 ft. beneath the ground surface, the use of the siphon greatly simplifies the development of the groundwater and makes unnecessary a multiplicity of pumping units for the 100 or more wells in use. The high water table is due to the fact that most of the gathering area for the underground supply is at an elevation higher than that of the city itself, and the character of the water-bearing material is such that wells of moderate size and depth are adequate to serve the city.

In the operation of the system, the suction leg of the siphon is formed by the well casing. The discharge leg is formed by a pipe carried to the bottom of the concrete well from which the high-lift pumps take their suction. These two siphon legs are connected by a line of cast-iron pipe with flanged joints buried below frost line, to which is connected a vacuum pump for removing any air and maintaining the negative pressure in the head of the siphon.

Instead of using individual siphons for each well, however, at each of the three development stations within the city, a number of wells are connected to one collector pipe and discharge into a single concrete suction chamber. A typical layout of wells and pipe lines is at Oliver Park station, a diagram of which is shown herewith. At this station 27 12-in. wells are arranged in two rows about 75 ft. apart. Between the rows is laid a collecting header pipe, varying in diameter from 8 in. to 36 in., to which each of the wells is connected by an 8-in. lead. The header pipe enters the wall of an 18-ft. diameter concrete well and by means of a downturned tee is carried to within a few feet of the bottom. The upstanding leg of this tee is covered with a blank flange into which is tapped a 2-in. suction connection from the vacuum pump. The pump is operated so as to produce a vacuum of 25 in. of mercury at this point and is provided with a 34-ft. high loop of pipe to prevent drawing water over. Direct-acting plunger pumps, taking their suction from this concrete well, force the water into the mains under operating pressure.

The flow of water through the siphon is entirely automatic, always equaling the amount discharged into the main by the high-lift pumps. Any increase in rate of pumping will have as an initial effect a lowering of the water level in the concrete suction well, which will, in turn, impress a greater head on the siphon and induce an increased flow from the wells.

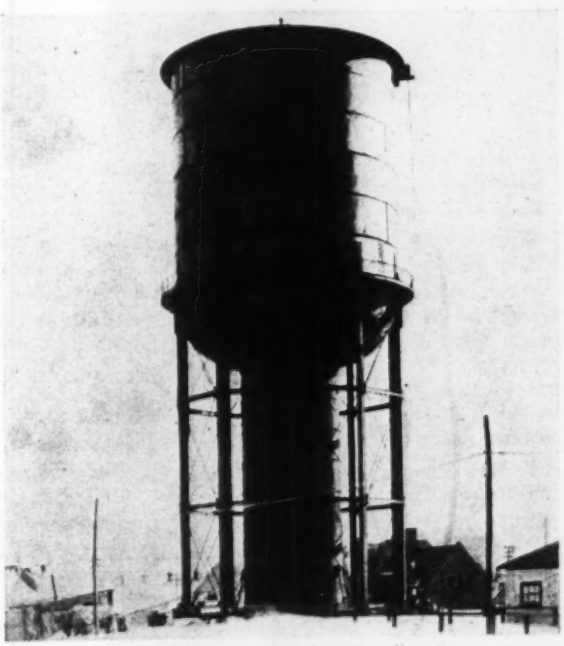
***Statistics of South Bend Water Supply***

Average day pumpage, 1929, 10 m.g. Maximum day pumpage, 1929, 26 m.g. Installed capacity of high-lift pumps, 15 m.g.d. Small boosted area at higher south end of city, connected with check-valves to remainder of system. 243 miles of mains, 75 per cent of which are 6-in. Lead service connections paid for by property owners. Consumption 100 per cent metered, with more than 24,000 meters in service. Meters owned and maintained by city. Fire hydrants, 1,800; water department receives rental of $40 per year each. Cross-connections between city supply and private well supplies permitted when protected by double check-valve installations.

## New Elevated Tank Built Around Old Standpipe

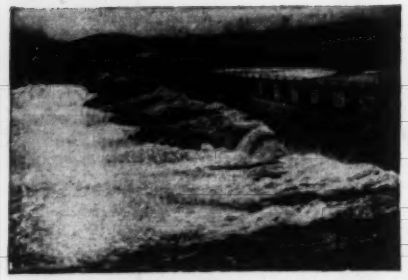
THE distribution system of Water District No. 4 in Toronto, Canada, has been served for twenty years by water storage in a steel standpipe 20 ft. in diameter and 100 ft. high. As a part of Toronto's extensive water-supply modernization program this standpipe has been modified by an interesting procedure into an ellipsoidal-bottom elevated tank of 600,000-imp.gal. capacity. The completed elevated tank, with the old standpipe serving as a riser, is shown in the accompanying illustration.

The tank has a diameter of 45 ft. and a shell height of 45½ ft. The top of the tank is 105 ft. above the foundations, allowing a 5-ft. freeboard over the original standpipe, none of which was removed. In order not to incur the expense necessary in removing the upper part of the standpipe and at the same time to alter it so that it would not interfere with the capacity of the tank, eight 12-in. holes were burned in the shell of the standpipe just above its intersection with the tank bottom. According to the Chicago Bridge & Iron Works, which held the contract for fabricating and erecting the tank, the removal of the 20-ft. diameter hole for the standpipe necessitated some fairly heavy sections to take the place of the metal cut out. A reinforcing plate 36x1⅞ in. and an 8x8x⅞-in. angle iron were required for connecting the suspended bottom to the standpipe.



ELEVATED TANK INCLOSING OLD STANDPIPE AT TORONTO, CANADA

The old standpipe proved of considerable benefit to the erector, the entire erection equipment consisting of a beam placed horizontally at the top of the old standpipe and mounted on a turntable so that it could revolve. This improvised overhead crane was used to lift all of the steel into place.



Wanaque reservoir—source for Newark and other cities in northern New Jersey

# Stored Water

## *How to Get, Preserve and Improve It*

### Among Factors Involved Are Reservoir Location, Hydrology of Stream, Topography of Watershed, Dam, Structures Needing Relocation, Sanitary Precautions and Silting

By Ezra B. Whitman

*Of Whitman, Requardt & Smith, Consulting Engineers, Baltimore, Md.*

IN MOST of the streams of the United States sufficiently free from pollution to serve as public water supplies, the dry-weather flow is so limited in amount that it is necessary to save water during periods of abundant flow in order that uniform draft may continue in time of drought. This requires a reservoir of a capacity determined by the uniform draft desired and the flow characteristics of the stream. For this determination a study of rainfall and runoff records on adjacent drainage areas must be made, unless direct data on the discharge of the stream are available.

The best location for a storage site is one fairly close to the city and having sufficient elevation to permit an economical connecting conduit. Furthermore, the topography must permit a dam of reasonable length to impound the necessary quantity of water. Geological conditions among other things must be carefully studied to make sure there will be no great leakage of impounded water through fissures in the underlying formations. With only one exception the water-supply dams constructed in the Eastern states are of solid masonry or of earthfill with masonry core-wall.

Before the reservoir can be allowed to fill, existing utility structures subject to inundation must be relocated. It is important that the drainage area of the impounded stream be cleared of any existing conditions likely to bring pollution to the reservoir. Usually, all vegetation and farm structures are removed from the site of the reservoir proper.

Due to silting, it is not unusual for reservoirs to be materially reduced in capacity over a long period of years. This same process, however, assists in purifying the water held in storage and after its stay in the reservoir the water has a better appearance and contains less contamination than it had before.

### *Location*

The location of a storage reservoir requires a study not only of the available sites but also of the cost of bringing the water to the consumers. The ideal situation is one where the storage reservoir can be located in close proximity to the place where it will be used. The city of Baltimore was exceedingly fortunate in being able to find a location about 7 miles beyond the city limits where water could be stored on the Gunpowder River. New York, on the other hand, was compelled to go over 100 miles to the Catskills in order to bring stored water to the city. The city of Albany could have secured water from near-by streams, but these were hard and seriously polluted, while streams yielding a soft and comparatively pure water were to be found in the foothills of the Catskill Mountains 20 miles away, at an elevation sufficiently high to permit a comparatively small pipe line to convey the water to the city. The elevation of the stored water above the city, which in a measure controls the size of the connecting conduit, has much to do with the location of a storage site. In a number of cases, cities are willing to spend greater amounts of money to secure pure upland waters rather than take near-by sources—rivers, lakes or wells—which have to be pumped and purified before the water can be used.

**NATURE has done better in providing rainfall sufficient in amount to meet the needs of man than in distributing the precipitation through the seasons and years. In consequence one of the major problems of the water engineers is to provide storage in times of plenty of rain for use during dry months or even a succession of dry years. Rainfall and runoff studies are, therefore, a part of his task, as is also the more obvious necessity of designing and building dams and reservoirs. Mr. Whitman discusses the storage problem in the accompanying article and at the same time outlines the necessary correlation between storage and aqueducts and treatment. —*Editor.***

### *Hydrology*

The most important study in connection with the use of stored waters is that of streamflow and possible yield from the watershed under consideration. If there are any gagings of the stream under consideration over a period of years, such information is the best possible basis for making such a study. Frequently, however, on smaller streams, there are no flow records or records having only a short history. Then it is best to select one or more near-by streams where suitable flow measurements have been taken and assume that the runoff from the proposed area will be the same per square mile as that of the near-by streams.

In making such a study it is best to be conservative in estimating. The streams which have been gaged are usually from a larger watershed and there may be wider variations on a smaller stream. One example of this is found in studying the records of the Cohocton River. Studies made over ten years ago of the flow of this

river were based on the flow of several near-by streams, including the upper reaches of the Susquehanna and Allegheny rivers. These streams showed a yield of more than 1½ sec.-ft. per square mile. About the time these first studies were made, a gaging station was installed on the Cohocton River; the new records show that the Cohocton River receives only 1 sec.-ft. per square mile. A study of the rainfall in these watersheds, however, establishes the fact that the rainfall on the watershed of the Cohocton is very much less than the rainfall on the others and this difference in rainfall readily accounted for the greater part of this difference in flow

The first accurate streamflow measurements made in this country, and studies of the available yield, were made on the Sudbury River. Curves showing relation between the yield in million gallons daily per square mile and the required storage to produce this yield were recently made after a study of the streamflow records of the Croton, Housatonic and Kinderhook rivers. The yield curves from these three streams produce curves in fairly close agreement and considerably above the yield from the Sudbury River basin.

The method of arriving at the yield available from any stream is to plot the streamflow, particularly for the dry years, as a mass diagram and then from this diagram determine what storage is required to give certain yields from the watershed under consideration. Those who are studying watersheds of small streams, however, should be careful in attempting to compute the yield of these small streams on the basis of the yield from streams of much larger watersheds. This is particularly true of the dry-weather flow of streams in small areas.

In the very dry early fall of 1920, in seeking a water supply for the city of Winchester, Va., the engineers made gagings of twelve adjacent small streams with watersheds varying from 7½ square miles to 92 square miles, and it was found that the flow of the streams during that dry period varied as greatly as from 0.02 to 0.20 sec.-ft. per square mile. This variation in flow is not so important where an engineer is figuring on a large amount of storage, but it becomes of increasing importance as the storage per square mile is reduced and where the problem is to secure a certain available yield with the smallest amount of storage and expense. With small cities this is the usual condition encountered, as the amount of money available for water-supply purposes is usually a very serious consideration.

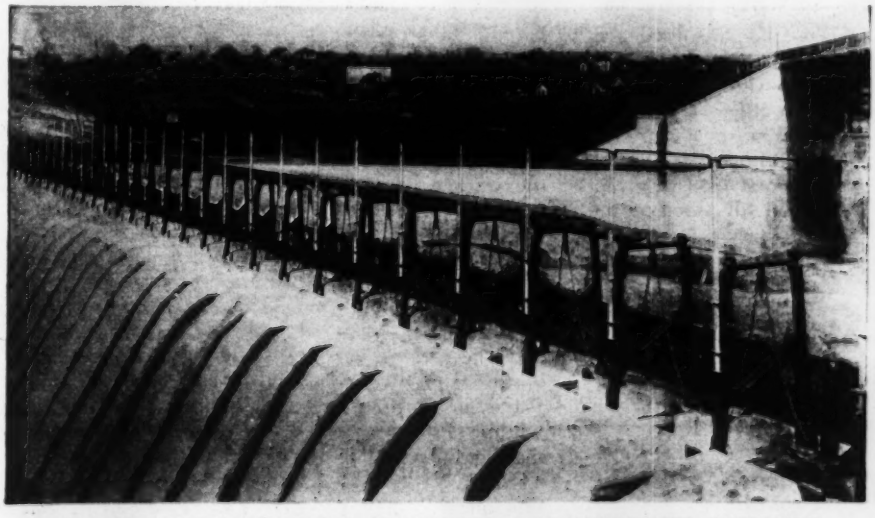
### *Topography*

In studying the possibilities of a stream as a source of stored-water supply for a city, the topography of the watershed is often a controlling factor. Many upland streams have steep watercourses in narrow valleys where it is impossible to secure large amounts of storage without great expense. On the other hand, other streams are in broad flat valleys which offer little opportunities for the building of a dam at a reasonable cost behind which to store the waters. The ideal watershed for storing waters is one where the topography is such that the stream flows through a broad flat valley into a comparatively narrow ravine. This narrow ravine makes an ideal site for the construction of a dam, and the broad flat valley behind it offers ideal conditions for securing a large amount of storage at minimum expense for the dam construction.

In studying the topography of a watershed with a view to using stored waters, the United States Geological Survey maps are of great assistance. These maps can be enlarged and the volume of storage between contours can be readily computed from planimeter measurements. It is dangerous, however, particularly with the older geological sheets, to make such a study without checking the elevations in the basin at a number of places. The writer has found several times that the Geological Survey sheets are in error more than 50 ft. in elevation. A quick method of checking elevations is by means of an aneroid barometer; for a preliminary study as to the possibilities of securing the proper storage reservoir, this instrument is sufficiently accurate.

### *Geology*

Not only the topography of the watershed but the geology of the reservoir basin as well should be studied with great care. This is especially true when it comes to the selection of the site for the dam. Many stream valleys are filled with a porous sandy gravel, and it may be that the depth of this material below the ground surface is so great that it would make the cost of a dam at such a point prohibitive.



**IN CENTRAL ILLINOIS DECATUR, ON THE SANGAMON RIVER, IMPOUNDS ITS SUPPLY WITH THIS STRUCTURE**

**The minimum yield is 42 m.g.d. The dam must pass heavy floods and the flashboard supports are hinged to fold flat into recesses in the crest.**

In limestone country such as the Shenandoah Valley and many parts of the Blue Ridge Mountain region, fissures in the limestone rock afford channels for underground streams many feet below the surface. At one point near Bristol, Va., there is a good-sized stream of water that disappears into the ground and comes out on the far side of a hill over a mile away. It will always be dangerous to select a reservoir site in such limestone country, as it is difficult to tell whether fissures may not reach the surface at some place in the reservoir area where they would carry away perhaps the full streamflow, so that the reservoir could never be filled.

The writer is familiar with another dam site where the rock in the bed of the valley suddenly dropped off 30 ft. A consulting geologist confirmed the fact that there was a fault in the underlying rock extending an unknown distance up the bed of the stream. The proposed site for this dam was abandoned. It is always helpful for an engineer to call in a geologist to aid in determining whether the site is a safe one or whether there is a possibility that there will be leakage in sufficient quantities to be a serious loss in the amount of water flowing in the stream.

### *The Dam*

The type of dam behind which to impound stored waters depends very largely on the topography of the dam site, the location of the rock and the character of the soil at or near the dam site. The types of dams most commonly used in the East are the solid masonry dams and the earthen dams with masonry core walls. Where there is a good rock foundation, comparatively near the surface, masonry dams for water-supply purposes are usually preferred. Where the rock is at such a depth that the cost of excavation for the wide base of a masonry dam becomes prohibitive, it is usual to build a dam with a thin cutoff wall extending into the ground to solid rock and with this wall extending above ground as a cutoff wall with rolled earthen embankment placed on the upstream and downstream sides.

The new water-supply dam for Springfield, Mass., now being built at Cobble Mountain in a deep ravine between high hills, is being constructed as a hydraulic-fill dam. This is the only dam in the East known to the writer that is constructed by this method for water-supply purposes. There have been many hydraulic-fill dams, however, built for hydro-electric purposes in the East, one of which is on the Mongaup River in New York State and the other on the Saluda River in South Carolina. The Saluda River dam is one of the largest dams in the country and required 11,000,000 cu.yd. of earth in its construction.

In selecting the type of dam to be used, the economy of construction is usually the controlling factor, although for a water-supply dam permanence and freedom from leakage are factors which have to be given most careful consideration and may become controlling in the selection of the type of dam to be built.

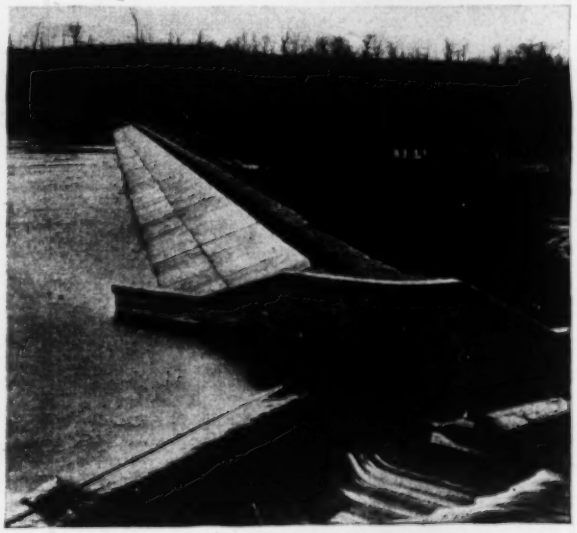
Another important factor in connection with the dam construction is the spillway for carrying off the flood-waters. A very careful study must be made of the rainfall and maximum runoff which may be expected, not only over a period of years but for the greatest flood that can possibly be anticipated. This requires a careful study of rainfall and floodflows not only in the immediate vicinity of the dam but in a large section over an area perhaps several hundred miles on all sides of the proposed dam.

### *Reservoir Requirements*

In studying the possibilities of a certain basin for a stored-water supply, careful attention must be given to the physical conditions of various structures which lie within the proposed reservoir basin. A careful survey must be made of all railroad lines, roads, telephone, telegraph and electric-power transmission lines and other structures which will be inundated and will need to be replaced outside of the reservoir area.

In the hydro-electric development on the Susquehanna at Conowingo the cost of relocating the Pennsylvania Railroad on the side hill above the reservoir ran into many millions of dollars. In some locations, particularly on the smaller railroads, not only is it necessary to relocate the railroads but damages due to loss of business in the area taken over must be paid to the railroads. With regard to the roads and highways lying within the reservoir area, a careful study must be made as to the length and type of reconstruction that will be required to replace the roads that will be flooded.

Where telephone and electric lines must be replaced, it may be necessary not only to estimate the cost of replacement, but as in the case of the railroads, it will also be necessary to figure on the damages due to the loss of business within the area taken over by the development. With telegraph lines, usually the relocation of the lines is all that is necessary to estimate.



BLOOMINGTON, IND., IMPOUNDS ITS SUPPLY BACK OF THIS DAM

The supply is Litfle Creek, which, under full development, doubling the height of dam, will furnish 4.5 m.g.d. in the driest 1-in-25 year. Present yield is 2.6 m.g.d.

The cost of purchasing property on a watershed for developing stored waters cannot be figured on the farm land value, as such lands always become more valuable when a city desires to purchase them. It has been the writer's experience that it will cost the city from two to three times as much to buy property on a watershed for water-supply purposes as the property owners could possibly realize by selling these properties for farm purposes. In many cases where it is possible to reach a reasonable agreement with property owners as to the value of the property, the extra cost of acquiring these properties through condemnation proceedings amounts to 50 per cent or more of the actual amount paid, and in estimating the cost of a water-supply development allowance must be made for this additional cost.

*Safeguarding the Watershed*—The sanitary conditions on the watershed tributary to the proposed reservoir must be given consideration. Where there are towns or industries discharging objectionable wastes, provision must be made for a very complete purification of the sewage. If possible, it is preferable to secure a watershed free from villages of more than a few houses. A study should be made of the density of the population per square mile of watershed, as the amount of pollution usually varies with the population. If storage alone is depended upon for purification, then this becomes a most important factor.

Not only must the possibility of pollution from human beings be considered but a study must be made of the

location and character of the various barnyards and pigsties or other sources of animal pollution. Within the reservoir area itself, all dwellings, barnyards and henhouses should be removed, and with them all manure and other similar material. The ground beneath manure piles should be removed to a point below the point of saturation from such deposits.

Not only must all polluting matter be removed within the area flooded by the reservoir but a careful sanitary survey must be made of the entire watershed. Where sources of pollution are near streams or valleys and such pollution would directly enter the reservoir, it may be necessary for the city to pay for the expense of taking care of the sewage from the houses and relocating barnyards, stables and other similar structures.

*Silting*—In the eastern United States the silting of reservoirs is not a serious factor unless the storage per square mile is small. The original Loch Raven reservoir on the Gunpowder River, with a watershed area of 307 square miles, was built for the water supply of the city of Baltimore in 1880. The original reservoir capacity was 510 m.g. In twenty years the capacity of this reservoir was reduced to 78 m.g. The city bought a suction dredge and had it in operation from 1900 to 1911, increasing the capacity of the reservoir in that time to 178 m.g. In 1911 a new dam was built just above the old one and stored two billion gallons of water. It was in operation from 1914 to 1923. In this latter year the dam was raised so that the amount of storage was 23 billion gallons. With the increased storage it was estimated that it would take over 300 years to silt up this larger reservoir. In the western and southwestern parts of the United States, silting is a much more serious matter, and there are a number of cases where the loss of storage has amounted to over 60 per cent of the capacity of the reservoir in less than ten years.

*Clearing Reservoir Site*—It is usual in modern practice to clear the reservoir site of all buildings, structures, fences, brush, bushes, vines, shrubs, trees, grass and weeds and other similar matter. Where the reservoir will be drawn down during periods of drought, it is also customary to grub all stumps between the low-water line and an elevation well above the high-water line.

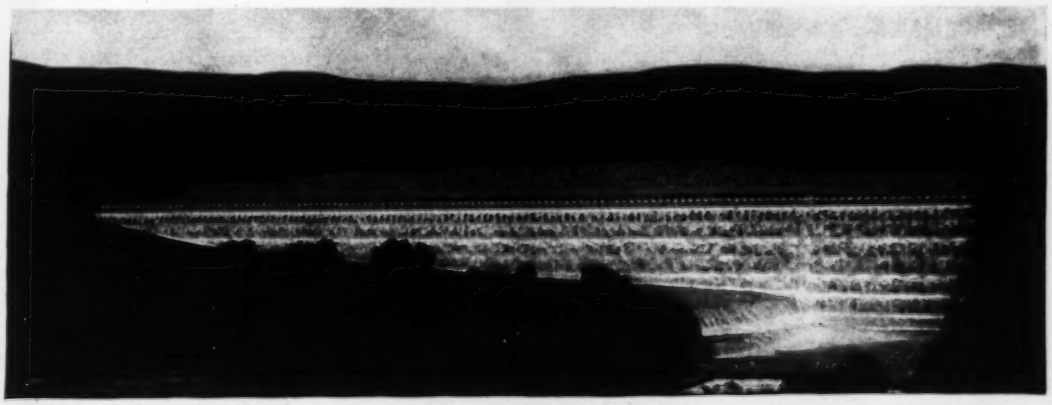
Thirty years or more ago, not only was it considered necessary to do the work above outlined but the topsoil containing organic matter of any kind was also removed from the entire surface of the flooded area. This was done at the Wachusett reservoir, constructed for the city of Boston. Experience since that time, however, would seem to indicate that this great expense is not warranted, and the writer knows of no reservoir constructed within recent years from which the topsoil has been removed.

The organic matter in the topsoil, which is largely of vegetable origin, does not seem to produce the serious consequences which were expected. In the engineering literature of 30 or 40 years ago, not only was great fear expressed of any organic matter being left under the surface of the reservoir but it was not considered a good plan to draw down the surface of the reservoir for a length of time which would make it possible for grass and underbrush to grow on the slopes. Again the writer knows of no instance where any serious harm has been done to the quality of the water by drawing down the reservoirs for a length of time that makes it possible for vegetation to grow on the uncovered part.

### *Purification by Storage*

The purification by storage was investigated by Sir Alexander C. Houston, of London, in his studies for the water supply of that city, and his conclusion, as a result of these studies, was that 30 days' storage in quiescent waters was practically equivalent to filtration. All of the cities using stored waters depend upon storage to a large extent for purification. Boston depends upon it entirely and does not even chlorinate the water. Most of the other cities where storage is depended upon use chlorination in addition. Some few of the cities, such as Baltimore, have filtration as well as storage and chlorination. In the case of Baltimore, however, filtration not only removes pollution, which, with its new large reservoir, is very slight, but it is depended upon for the removal of turbidity. The water of the Gunpowder River carries large amounts of colloidal clay; this finely divided matter will stay in suspension for an indefinite period, and is removable only by proper filtration.

It seems to the writer that a number of our cities could profitably follow the example of London and secure their water supplies from near-by sources, which may be polluted to a certain extent, by first storing these waters in large reservoirs and then filtering them. Where such a procedure could be worked out with greater economy than would be the case by going long distances to secure supposedly pure upland waters, it would be not only economical but proper. With the upland sources where storage alone is depended upon, there are times during heavy rains when the turbidity reaches objectionable amounts and there is always the danger of pollution being washed into the reservoir near the point of outlet, where damage could be quickly done to the health of the community.



THE 1,300-FT. SPILLWAY OF THE GILBOA DAM, NEW YORK CITY WATER SUPPLY

# Constructing a 14-Mile Tunnel for Boston's New Water Supply

## Work Carried On Through Seven Shafts by Variety of Drilling and Mucking Methods—Present Development Taps Ware River, While Future 11-Mile Extension Will Reach to Swift River, Giving City 191 M.G.D. Additional Supply

DRIVING of the 14-mile Wachusett-Coldbrook tunnel for Boston's water-supply system was completed by the middle of the summer, and the concrete lining, started in March of this year, will be finished early in 1931. This will complete the first unit of the Metropolitan District Water Supply Commission's program to provide the city with an additional 191 m.g.d. supply. The tunnel outlet is at the present Wachusett reservoir, 9 miles northeast of Worcester and 40 miles west of Boston, and the first intake at Coldbrook, on the Ware River, 13 miles west of the outlet. This floodflow, approved by the War Department, allows the taking of all water in excess of 85,000,000 gallons daily between Oct. 15 and June 15. Plans call for extending the tunnel an additional 11 miles westward to tap the Swift River, though at present this work is being held up by interstate litigation with Connecticut.

Eight shafts were sunk on the Wachusett-Coldbrook section, including the outlet shaft and the intake at Ware River, varying in depth from 221 to 656 ft. A plan and profile of the tunnel with the locations of the shafts are shown in Fig. 1. A contract for sinking shafts was let March 28, 1927, and two months later two contracts were let for sinking respectively shafts 6 and 7, and shafts 2, 3 and 4. Under the shaft contracts, the contractors were permitted to start tunnel driving upon reaching invert grade and to continue until the tunnel contracts were let. By the time the general tunnel contracts were awarded, April 30, 1928, about 1.6 miles of tunnel had been driven by the shaft contractors. The contract for the tunnel was let in two sections of approximately equal length to two contractors. Contract for the east section included the sinking of shaft 1, and the west section work included the sinking of shaft 8. Both contractors assigned their contracts to a third.

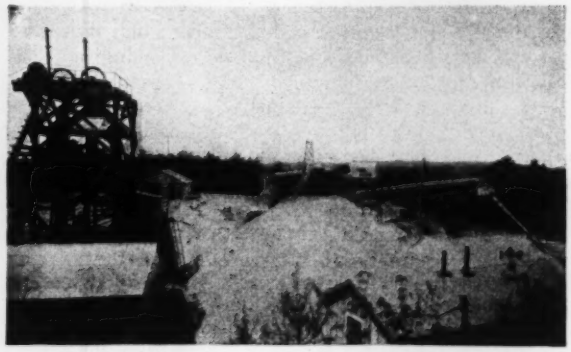


FIG. 2—SURFACE CONCRETE PLANT LAYOUT, SHAFT 5

Headframe over shaft at left. Conveyor belts leading to aggregate storage piles in foreground. Blower pipe to remove dust from fine aggregate can be seen hanging from belt conveyor at right.

*Design*—For the most part the tunnel consists of a horseshoe-shaped section, shown in Fig. 3, equivalent to a circle 12 ft. 9 in. inside of concrete lining. A circular

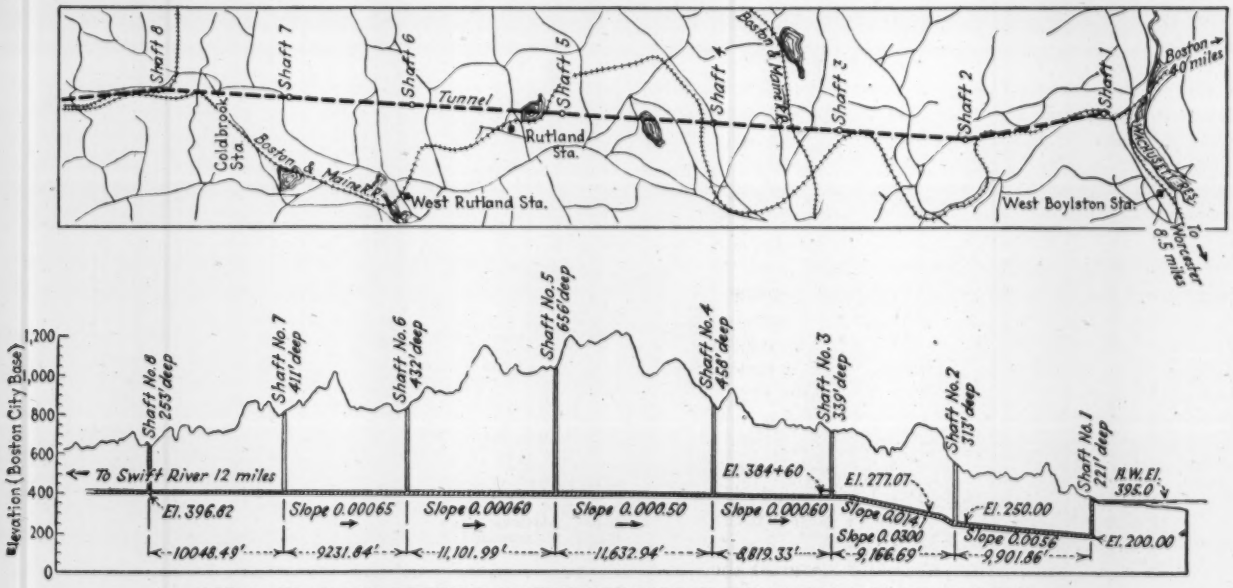



FIG. 1—PLAN AND PROFILE, WACHUSETT-COLDBROOK WATER TUNNEL, BOSTON

section was used for 500 ft. from the outlet at shaft 1. Very little timbering was required, as the rock was uniformly hard, except near shafts 3 and 7, where short stretches of timbering were necessary. Several spots showing a tendency to disintegrate in the presence of air were gunited, which saved considerable timbering. Shaft 1, the outlet, is oval-shaped, and will contain a steel riser with two horizontal openings at the top for discharge and a separate steel riser containing a pump for dewatering the tunnel if necessary. As the discharge at the top of shaft 1 may later be under a 100-ft. head, provision is made for the installation of a hydro-electric plant, but this will not be placed until the Swift River tunnel section and the Swift River reservoir are completed. A venturi meter will be installed in the outlet shaft, and weirs provided for measuring small flows.

Control works and a diversion dam are being installed at shaft 8 on the Ware River. This shaft, 19 ft. in diameter, is being lined with cast-iron plates inside of a concrete lining, the plates having helical flanges on the inside that will give the water a swirling motion as it drops, designed to dispel the energy created by the drop and to protect the concrete shaft lining against impact. The general plan of the control works is to divert the water through several siphon spillways of various capacities, which will insure the complete diversion above the prescribed limit and prevent any diversion below this limit. These spillways will discharge into a large well directly over the shaft. From this well the fall into the shaft will be controlled by four large butterfly valves automatically maintaining a water seal for the exclusion of air and insuring the submergence of a venturi meter set vertically over one of the valves, the meter having a capacity of 800 million gallons daily. For extreme floods in excess of this amount the quantity may be estimated from measurements at other points.

*Shaft Sinking*—Methods of sinking of shafts 2 to 7, inclusive, all 14 ft. in diameter, were practically the same after the pits had reached rock. Shaft 3 passed through 61 ft. of earth before striking ledge, so a reinforced-concrete caisson 14½-ft. inside diameter, with 32-in. walls, was sunk in 8-ft. sections for this earth section. The earth sections in the other shafts, averaging 25 ft. deep, were timbered as excavation progressed. A typical shaft-drilling round in rock consisted of nine center-cut holes 9 ft. deep, twenty rim holes 8 ft. deep and ten relievers 8 ft. deep, placed in an intermediate ring. The firing order was: center cut, instantaneous; relievers, second delay, skipping the first delay; rim holes, third delay. All these shafts were equipped with a wood or steel headframe after a depth of 60 ft. had been reached.

Rock was encountered 3 ft. below the surface at shaft 8, which is 20 ft. in diameter. A typical drilling round consisted of eight center-cut holes 9 ft. deep, and three concentric rings all 7 ft. deep of 10, 16 and 40 holes. The center cut and each ring were fired separately.

Shaft 1 was excavated with natural slopes to 21 ft., then steel sheeting and a timber crib were used for the remaining 9 ft. to rock. Blasting the rock proceeded in two parts, a center section being fired in one shot and the two end sections in a subsequent shot, using a total of 49 holes 9 ft. deep in one to four delays.

No headframe was installed at shaft 1, either for the shaft sinking or for the subsequent tunnel driving, a stiff-leg derrick serving as hoist. Wood forms were used for the concrete lining of all shafts.

As the two tunnel contractors had assigned their contracts and the entire work was to be prosecuted as a unit, it was decided to operate from shafts 2, 4, 5, 6, 7 and 8, driving in both directions from each shaft, and to drive but a short distance from shaft 1. To balance the work at shaft 8, the contractors were permitted to drive westward on the Coldbrook-Swift section a distance of 5,000 ft., which brought the total length of bore driven under the present contracts to 14.2 miles.

*Drilling and Mucking*—From shafts 2 and 4 a full-face heading was used. Drilling and shooting diagrams, showing the location, depth and direction of the 32 holes in each round and the shooting arrangement, are given in Fig. 4. Drilling was done by three drifter drills at each heading, operating on two crossbars.

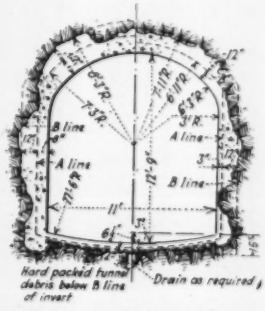
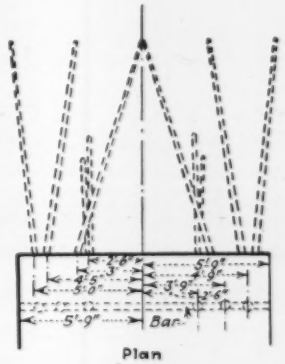
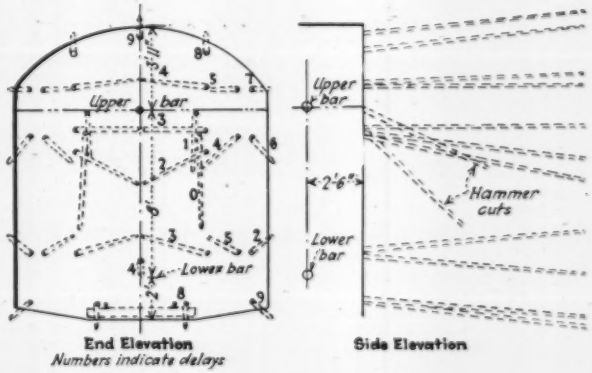



FIG. 3 — TYPICAL HORSESHOE TUNNEL SECTION IN SOLID ROCK




| Name of Hole | Location of Drills Right and Left Drills | Depth, Hole | Delay |
|---|---|---|---|
| Upper cut | Over top bar | 10'6" | 4 |
| Upper rib | Over top bar | 10'0" | 7 |
| Upper reliever | Over top bar | 10'0" | 5 |
| Center cut | Under top bar | 10'6" | 3 |
| Lower cut | Under top bar | 10'6" | 2 |
| Center rib | Under top bar | 10'0" | 6 |
| Center reliever | Under top bar | 10'0" | 4 |
| 7 holes | Top bar | 71'6" | |
| Lower rib | Over lower bar | 10'0" | 7 |
| Lower reliever | Over lower bar | 10'0" | 5 |
| Side lifter | Under lower bar | 10'0" | 9 |
| Center lifter | Under lower bar | 10'0" | 8 |
| 4 holes | Lower bar | 40'0" | |
| | Center Drill | | |
| Left back | Arm on top bar | 10'0" | 8 |
| Center back | Arm on top bar | 10'0" | 9 |
| Right back | Arm on top bar | 10'0" | 8 |
| Left lower hammer | Over top bar | 6'6" | 0 |
| Left upper hammer | Over top bar | 6'6" | 1 |
| Right lower hammer | Over top bar | 6'6" | 0 |
| Right upper hammer | Over top bar | 6'6" | 1 |
| 7 holes | Top bar | 56'6" | |
| Left bottom cut | Over lower bar | 10'6" | 3 |
| Bottom reliever | Over lower bar | 10'0" | 4 |
| Right bottom cut | Over lower bar | 10'6" | 3 |
| 3 holes | Lower bar | 31'0" | |
| Right machine | 11 holes | 111'6" | drilling |
| Center machine | 10 holes | 87'0" | drilling |
| Left machine | 11 holes | 111'6" | drilling |
| Round | 32 holes | 310'0" | drilling |
| Delay exploders | 0 1 2 3 4 5 6 7 8 9 | | |
| Quantity for round | 2 2 2 4 5 4 2 4 4 3 | | |

FIG. 4—DRILLING AND SHOOTING DIAGRAM, FULL-FACE HEADING SYSTEM

Drilling crews alternated between the two headings driven off of each shaft, working on three 8-hour shifts. Mucking crews alternated with the drillers on the headings, also working on 8-hour shifts. Headings were completely mucked out before a new round of drilling was started.

In drilling these full-faced headings, a drill carriage was used to good advantage. The carriages contained air-line manifolds and carried all drill steel and the crossbars. Their use speeded up the time getting set up for drilling, and after a round was completed by loading all drills, bars, hose and drill steel on the carriage, all the drilling equipment was easily shifted out of the way of the mucking crew.

On this east section electrically operated mucking machines were used, loading into 46-cu.ft. cars running on a 36-in. gage track. Storage-battery locomotives handled the cars from the headings to the shafts. Each shaft was equipped with a double cage hoist. A "cherry picker," or overhead air hoist, operating on a cross I-beam switched the cars in the tunnel from stub-end storage tracks at the headings to the loading tracks.

The heading and bench method was used in driving the tunnel off shafts 5 to 8 inclusive. Drilling and shooting diagrams of this method are shown in Fig. 5. An 8-ft. bench 6 ft. high was usually carried. A typical round consisted of 28 holes averaging 8½ ft. deep in the heading and six holes averaging 7 ft. deep in the bench. Drills for the headings were supported on columns, and a horizontal bar was used in drilling the benches. Delay exploders from 0 to 5 were used in firing. The crews remained at one heading, alternately drilling and mucking out, working two 10-hour shifts daily.

Mucking out at first was done by hand, but later in the progress of driving all headings were equipped with small air-operated mucking machines. One notable difference in mucking operations between the east and west sections was the use of mules to handle cars between the headings and shafts on the west section. Track of 30-in. gage was used off shafts 5 and 6 and 24-in. gage track was used off shafts 7 and 8. Both these gages were changed to 36 in. before starting concrete lining.

At all of the shafts on both sections the muck was handled at the surface by gasoline dinkeys. At shaft 8

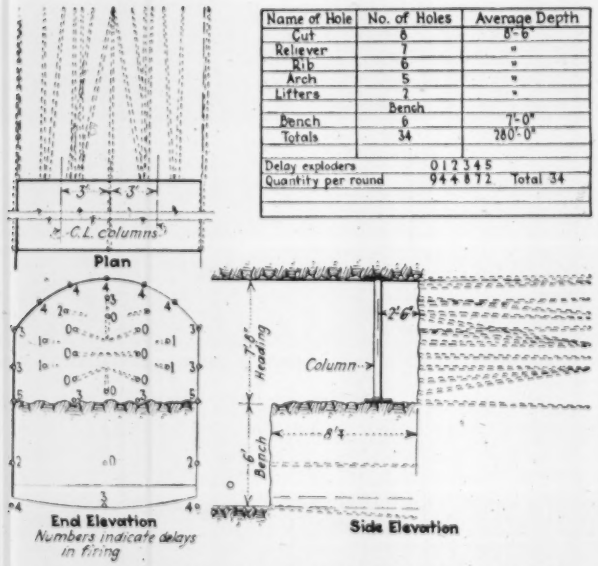



FIG. 5—DRILLING AND SHOOTING DIAGRAM, HEADING AND BENCH SYSTEM

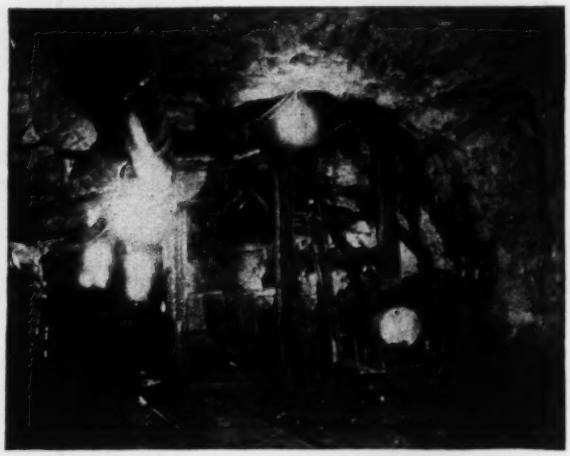


FIG. 6—BOTTOM OF SHAFT 2 SHOWING WOOD-STAVE VENTILATING PIPE

the spoil was dumped along the Ware River, close to the banks, and was carefully leveled and trimmed to present a good appearance.

*Ventilation and Drainage*—Forced ventilation was used throughout the entire length of the tunnel, blowers being located at every shaft from which driving was progressing. Part of the ventilation-pipe system was light gage 12-in. steel pipe, but for the most part 14-in. wood-stave pipe was used, brought in from the West Coast. The wood pipe, though higher in first cost, proved to be very durable and tight and less likely to be damaged by flying rock.

Water from headings above the elevation of their corresponding shafts drained into sumps at the shaft. From the other headings it was pumped back to the sumps by air pumps. At the sump 300-gal. four-stage electrical pumps were installed. A heavy inflow of water was encountered between shafts 7 and 8, which required additional pumping equipment to handle.

*Surface Plant*—Electrically driven compressors were set up at each of the eight shafts. Power was taken from a 22,000-volt transmission line covering the entire job, and stepped down to 440 volts. Electric hoists operating at 650 ft. per minute handled the shaft cages. Air-operated drill sharpeners and oil furnaces were used throughout. Storage-battery charging stations were provided at shafts 2 and 4, and later at shaft 5 when concrete lining was started.

*Concrete Lining*—The tunnel will be lined throughout its entire length. At shafts 5 and 7 two complete concrete plants have been installed, a feature of which is the placing of the mixers underground at the point of concreting operations. The plant at shaft 7 will line the bore from shaft 6 to the extreme west end, 5,000 ft. beyond shaft 8. This plant will probably be moved to shaft 2 when its present work is completed. From shaft 5 the other plant will line the section between shafts 6 and 3. The procedure is to start at the far end of the section to be lined and work toward the shaft at which the plant is situated, the underground equipment being designed to permit turning it around within the tunnel when the shaft is reached.

Tunnel muck is the basis of all aggregates used in the concrete lining. An unusual feature of the use of the tunnel spoil is the sufficient amount of fines present to supply all the need for sand without further crushing. This fine material was the result of heavy shooting in the tunnel.

The two concrete plants at shafts 5 and 7 are practically identical. The aggregates are crushed, screened and proportioned at the surface, chuted down the shaft, and hauled in cars to the mixer at the form. A slackline-cableway drag scraper brings the muck from the spoil-banks and dumps it through a grizzly into a primary jaw crusher. From this crusher the material goes by belt conveyor to a rotary screen, where the fines are screened out, and then all aggregate too coarse to pass through 1¼-in. holes is fed through a secondary gyratory crusher for further reduction. The sand (all material under ⅜ in.) and screened coarse aggregate are then taken to two storage piles by belt conveyors.

The screening and crushing plants, remarkably simple and efficient, have three interesting features in their operation that deserve notice. One is the use of a lifting magnet, suspended over the conveyor belt leading from the primary crusher, that collects a surprisingly large amount of tramp iron such as bolts, broken drill steel and track spikes. As the plants were started in mid-winter, considerable trouble was encountered due to frozen and damp material coming from the dumps. The fines were consolidated into lumps or stuck to the larger pieces, going over to the coarse aggregate stockpiles. This trouble was successfully overcome by the ingenious arrangement of four open-flame oil burners hung from a longitudinal I-beam placed within the rotary screen. When the material is merely damp and not frozen, one or two of the burners is sufficient to cause the fines to separate.

It was found that too much real fine material was present, fine enough to pass a 200-mesh screen. To get rid of this dust, a 12-in. blower pipe was installed beneath the sand belt conveyor leading to the stockpile, opening directly against the stream of sand pouring from the end of the conveyor. The objectionable dust, removed by the blower action, is collected in a sheet-metal hood, and falls down a 12-in. pipe and is washed away by a water stream (Fig. 2).

A 5x5-ft. timber tunnel passes directly under both sand and stone stockpiles, with one opening under each. A single belt conveyor takes both aggregates to the shaft, where they are dumped to a hopper at the bottom through an 8-in. pipe. Weighing batchers are installed in the tunnel openings, and the materials are proportioned for a 1-cu.yd. batch at a time. As the batch is being dumped down the pipe shaft, the correct amount of cement is added at the top of the shaft by another weighing batcher. A complete signal system connects the shaft bottom with the cement, sand and stone batchers, so the material is dumped as needed.

Fig. 7 shows the arrangement of the underground

FIG. 8—STEEL FORMS FOR LINING, SHOWING ONE SECTION COLLAPSED READY TO MOVE FORWARD INSIDE OF SET-UP SECTIONS

plant. The hopper at the shaft bottom dumps into two-batch cars, which are hauled in four-car trains by storage-battery locomotives to the mixer, located at the forms. Three trains and two locomotives are used up to a 10,000-ft. haul. A third locomotive is kept for switching at the shaft and to prevent delays when changing batteries, as the concreting is continuous in three 8-hour shifts. Four trains are used in longer hauls than 10,000 ft. From Fig. 7 it can be noted that the passing tracks, 81 ft. long, the 1-cu.yd. mixer and the air gun are all mounted on trucks operating on the tunnel track. Jack outriggers steady the mixer and gun. A small air hoist pulls the loaded cars one at a time up an incline next to the mixer, where the batchers are dumped onto a belt conveyor discharging into the mixer drum. Water for the mix is carefully measured to give the concrete a slump of about 6 in., the consistency best suited to the gun operation.

From the gun the concrete, a cubic yard at a time, is blown through a 6-in. pipe to the forms, the pipe being carried on a traveler to reach the top of the forms. Instead of removing pipe sections at the point of concreting as the forms fill up, sections are taken out between the

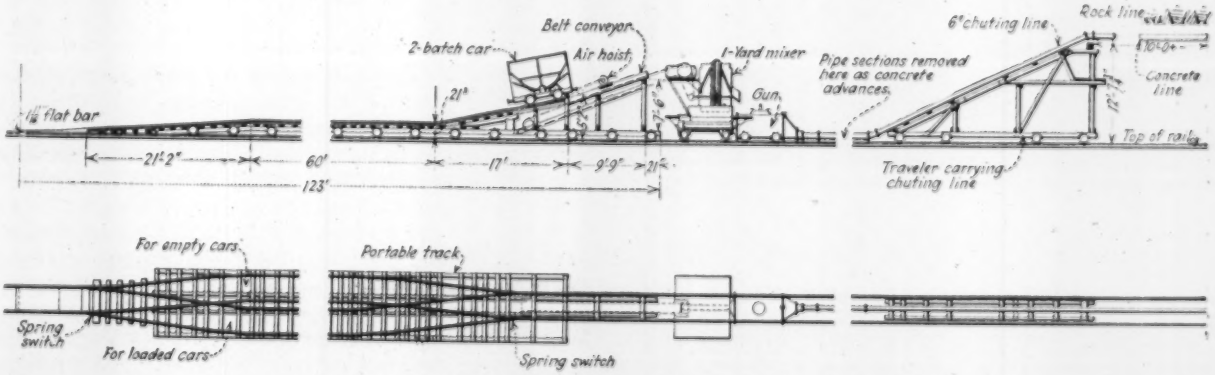



FIG. 7—LAYOUT OF PORTABLE UNDERGROUND CONCRETE-LINING PLANT

gun and the pipe-carrying traveler, and the traveler and entire pipe length over the forms are moved forward. This scheme permits the removal of pipe sections out in the open, where they are of easy access, rather than removing them in the narrow space between the forms and the tunnel arch.

Eight sections of steel collapsible forms are used, each 25 ft. long, or 200 ft. total, riding on wooden sills, as the plan of lining is to pour the arches and sidewalls for the entire length before pouring any of the invert or shoulders. These form panels are hinged in three places, at the crown and at both sidewalls, about 3 ft. above the bottom. When a section is to be moved forward a traveler is run under it, and the section is collapsed, the lower sides folding inward. Jacks on the traveler lower the form far enough to clear the sections in place. The section is then moved forward through the other sections and is set up at the end without disturbing or interrupting the concreting operations (Fig. 8).

The average run in 24 hours is 300 cu.yd. of concrete, about 140 ft. of tunnel lining. This schedule allows the forms to remain in place about 30 hours every pouring. The mixer, gun and passing track are moved ahead every

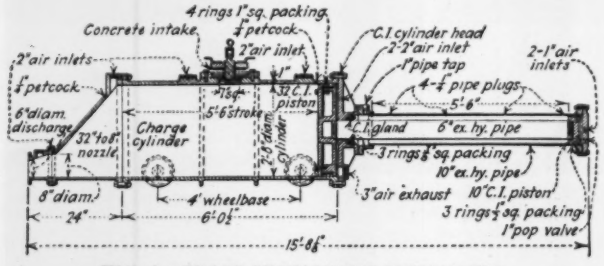



FIG. 9—CROSS-SECTION OF PNEUMATIC CONCRETE GUN

change of shift, being easily handled by one of the storage-battery locomotives.

Fig. 9 shows details of the concrete gun being used, developed and patented by W. F. Webb, who is in charge of the tunnel lining. The cylindrical chamber, 32 in. in diameter, holds a cubic yard of concrete. After the receiver gate is closed, the piston is forced forward and the concrete is picked up by air admitted into the chamber at several points.

All of the underground concrete plant, except the locomotives, is operated by air; even the mixer uses a 7x9-in. engine. The plant is very successful in operation, and a steady yardage is being maintained without trouble. Difficulty in keeping the invert free of water causes the most inconvenience.

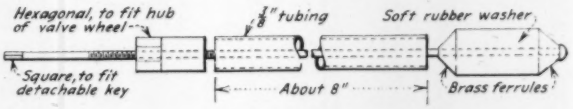
*Organization*—The Metropolitan District Water Supply Commission was established by the Massachusetts legislature in 1926 for the purpose of constructing the tunnel. Frank E. Winsor is chief engineer and Karl R. Kennison is designing engineer for the commission, X. H. Goodnough and J. Waldo Smith are consulting engineers, and Prof. Charles P. Berkey of Columbia University is consulting geologist. William W. Peabody and Richard R. Bradbury are division engineers resident on the project.

The original contracts for the east portion of the tunnel were awarded to J. P. Porter & Sons, Portland, Ore., and for the west portion to J. P. Porter & Sons and J. J. Coughlan & Sons, the latter firm of Boston. The east section was assigned to the West Construction Co., a subsidiary of Northern Construction Co., Stewart & Welch, and J. P. Porter & Sons. The West Construction Co. was associated with J. J. Coughlan & Sons on the west section. The driving off shafts 7 and 8 was sublet to Carleton & Rankin. A. C. Dennis was general manager of West Construction Co. until Jan. 1, 1930, when William Smaill, chief engineer of the company, took active charge, and Harry Carleton was made general superintendent. W. F. Webb, of San Francisco, is in charge of the concrete-lining work. Shafts 5, 6, 7 and 8 were sunk by J. J. Coughlan & Sons. Shafts 2, 3 and 4 were sunk by the Dravo Contracting Co., Pittsburgh. The Pennsylvania Drilling Co., Pittsburgh, made all the test borings on the tunnel line.

## Shop-Made Plug for Small Pipes

By C. W. Biladeau
*Superintendent of Water-Works, Pittsfield, Mass.*

ALTHOUGH all service pipes now laid by the Pittsfield water department are fitted with curb shut-off valves, considerable trouble with older installations not so equipped has led to the development of a home-made device for temporarily plugging such pipes when repairs




TEMPORARY PLUG TO SHUT OFF BROKEN WATER PIPES

are necessary. The device, details of which are shown in the illustration, is so arranged that it will stop the flow of water and permit the installation of a valve without making it necessary to close off the street main. It consists of a small rod threaded through a nut and extending through a piece of tubing about 8 in. long. At the opposite end of the tube the rod carries a soft rubber washer between two brass ferrules. A detachable key, not shown in the illustration, is used to turn the rod in relation to the nut, which is held stationary by a loosely fitting handwheel attached over the hexagonal end. This handwheel was taken from an old valve; other parts of the mechanism were made up in the water department shops from scrap material.

The plug is used only when trouble develops in a service line. To make a repair, the first step is to cut the pipe and insert the plug well into the open end. Turning the rod then compresses the rubber washer, which expands laterally against the sides of the pipe, effectively blocking the flow of water. Although the operator of the plug gets a thorough wetting, this is usually preferable to shutting off the entire street main, which often requires the closing of a number of valves, with resultant interference to other water users.

As soon as the plug is tightened and the key and handwheel removed, it is a simple matter to thread the end of the pipe and install a standard shut-off valve, after which the plug is removed through the valve, which is closed until a length of pipe can be spliced into the break. With dimensions approximating those in the illustration, the plug can be used for pipe sizes of from ½ to 1 in. by simply changing the size of the rubber washer. For larger sizes of pipe it would be advisable to increase the dimensions somewhat, in order to increase the strength of the parts.

# *Eleven-Mile Canyon Reservoir Permits Denver to Use Full Storage of Lake Cheesman*

By D. D. Gross
*Chief Engineer, Board of Water Commissioners, Denver, Colo.*

PROVISION of new storage of infrequent flood-waters on the South Platte River is the purpose of the Eleven-Mile Canyon Reservoir to be built by the Denver board of water commissioners. The site of the new reservoir is several miles above Lake Cheesman, the city's principal storage reservoir. After the new reservoir is filled the whole capacity of Lake Cheesman can be utilized each year, while at present a large portion of the storage in Cheesman must for safety be retained for use should the year prove to be an exceptionally dry one.

Lake Cheesman has a very early water right to store some 79,000 acre-ft. each year. It was built to hold this amount. The available storage supply is intermittent. Some years it does not amount to 79,000 acre-ft.; in other years it is much more than that amount. The result is that if the reservoir is emptied and filled each year, the average annual supply that it will deliver is 59,000 acre-ft. It would be an ideal supply on that basis for agricultural purposes. In 1914 Denver paid the Denver Union Water Co. for this storage development on the basis that it would furnish 54,000 acre-ft. per year when emptied and filled each year. The value of the water was fixed at $55 an acre-foot, making a total value of $2,970,000.

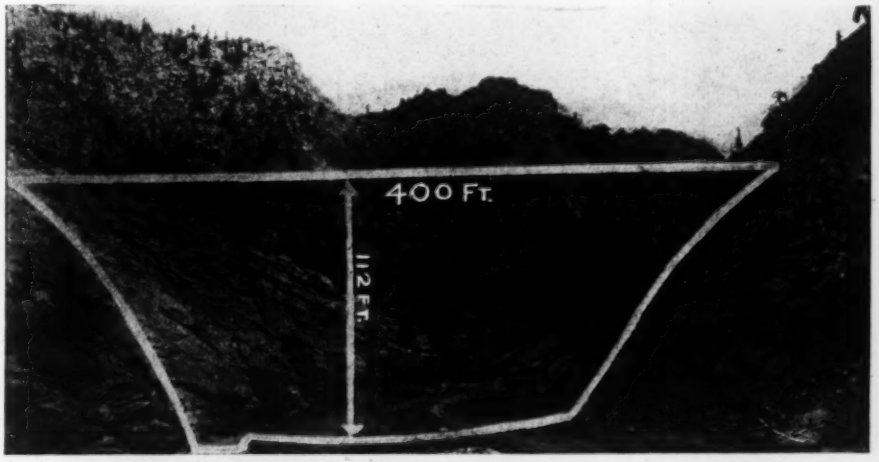
As a part of Denver's domestic supply, this reservoir cannot now be emptied and filled each year. Denver has a combination of direct-flow rights supplemented by the small amount of water that can be obtained from Antero reservoir, above the Eleven-Mile site, and the large storage supply obtained in the operation of Lake Cheesman. Lake Cheesman, as now constructed, performs two functions, the most important of which is to hold 50,000 acre-ft. of water in reserve for use in long periods of drought. This means that, under normal conditions, Lake Cheesman can empty and fill only the upper 29,000 acre-ft. of its capacity. It cannot, therefore, avail itself of the opportunity to empty and fill each year.

The time has come when it must be determined whether or not an additional reserve-storage capacity is to be built in some place on the river to hold the 50,000 acre-ft. of reserve supply for low-water years. Up to now the city has not needed all of the 29,000 acre-ft. storage in Lake Cheesman that is available over and above drought reserve. The city has used on the average only 20,000 acre-ft. per year, so that an additional average annual delivery of 9,000 acre-ft. is still available.

The Eleven-Mile Canyon Reservoir site has been found to be the most economical location, from the standpoint of cost, to construct reserve storage capacity. The board of review report, made in 1922 (see *Engineering News-Record*, Aug. 31, 1922, p. 360), reached the conclusion that eventually for all purposes something like 500,000 acre-ft. of storage capacity will be developed on the South Platte above the canyon, if the entire conservation of the river is completed. The water supply flowing through Lake Cheesman reservoir is in such proportion to the entire river flow that Lake Cheesman's proportionate capacity is 79,000 acre-ft. That of Antero is 33,000 acre-ft., and of Eleven-Mile Canyon 80,000 acre-ft.

On the South Fork, for Cheesman, Antero and Eleven-Mile Canyon reservoirs there is an annual storage supply of 58,226 acre-ft. for Cheesman, 11,905 for Antero, and 11,511 for the Eleven-Mile Canyon site. It is not believed that the 11,500 acre-ft. of water available at the Eleven-Mile Canyon site will furnish much additional annual storage supply, due to the fact that the flow is highly variable, and the greatest value of the flow will be to permit of holding a reserve supply at Eleven-Mile Canyon reservoir. Such supply will make available the surplus average supply at Cheesman (59,000) over present use (29,000), or about 30,000 acre-ft.

Based on the original purchase price of $55 per



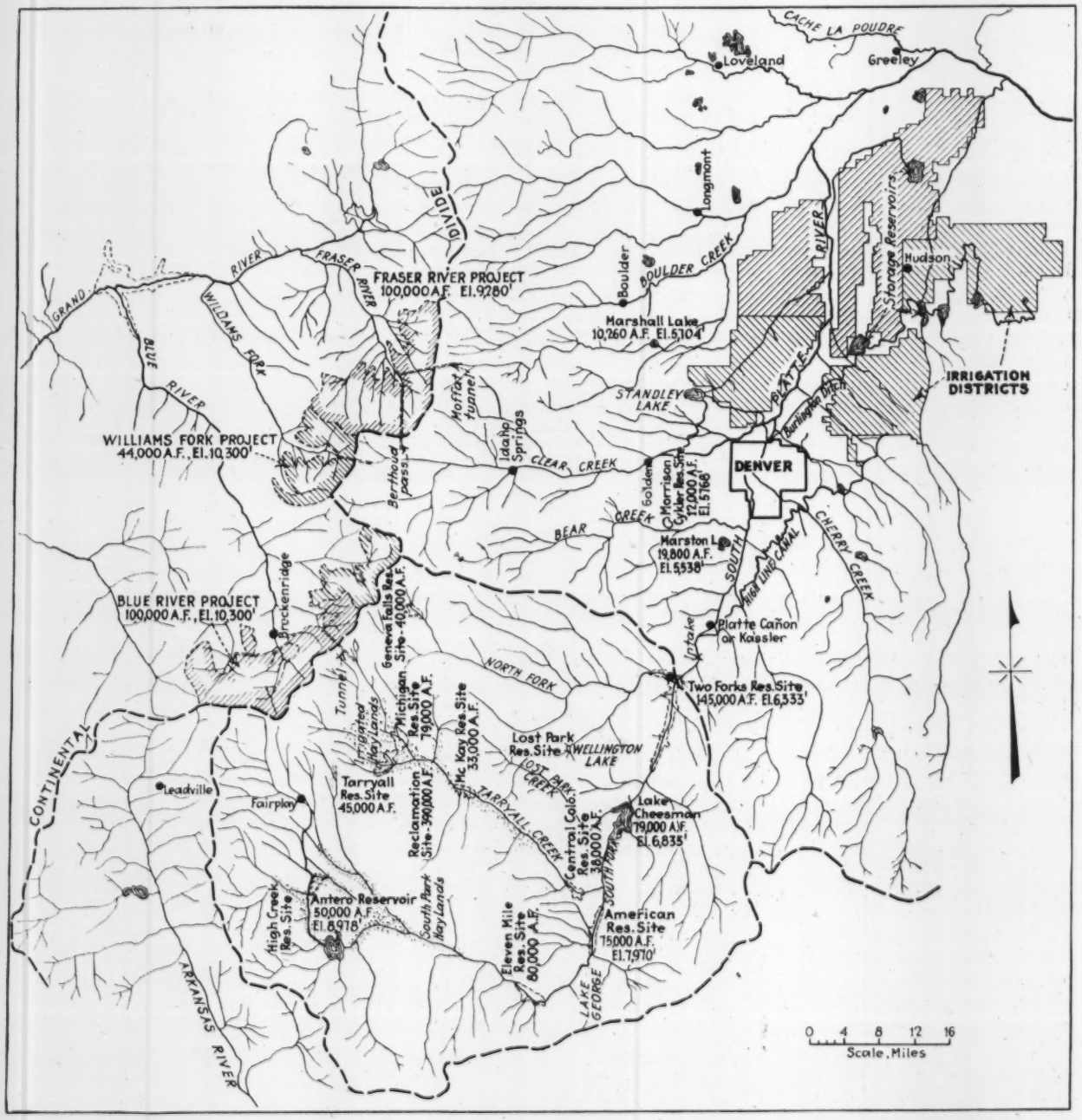

**WHERE THE ELEVEN-MILE CANYON DAM WILL BE LOCATED BETWEEN ROCK WALLS**
Arched dam 112 ft. high, containing 50,000 cu.yd. of concrete, will have a radius of 270 ft. and be 53 ft. thick at maximum section and 15 ft. at top.

acre-foot, there is a value of $1,650,000 in these 30,000 acre-ft. made live in Cheesman. The estimated cost of Eleven-Mile Canyon reservoir, including dam, highways, right-of-way for the reservoir and contingent expenses, is $1,150,000, or $300,000 less than its value. With an equivalent annual delivery of 30,000 acre-ft. the cost of the Eleven-Mile Canyon development per acre-foot is $38.33.

The city has sufficient water per annum to furnish 122,000 acre-ft. of filtered water. But this amount includes the 30,000 acre-ft. of Lake Cheesman water not now available because of the necessity of holding carry-over storage in reserve. The question of whether additional water rights should be bought at the canyon or water be brought from the western slope in various places is in no way an alternate consideration to additional storage capacity on the South Platte for the purpose of completely using the water supply available under the Lake Cheesman rights. In short, eventual use of the entire supply capacity of Lake Cheesman is essential to Denver's future water supply from the South Platte River.

Contract for the construction of the Eleven-Mile Canyon dam was let Aug. 21, and the work is to be completed in 1932. Funds, to be obtained from current revenue only, will be available as follows: 25 per cent in 1930, 50 per cent in 1931 and 25 per cent in 1932.

The analyses of the water-source situation were made and plans for carrying out the work on the Eleven-Mile Canyon project have been worked out jointly by George M. Bull, consulting engineer, and the writer.




STORAGE AND SOURCES OF WATER ON SOUTH PLATTE RIVER ABOVE DENVER AND IRRIGATED AREAS

# River and Lake Supplies

## Basic Requirements When the Source Is a Natural Body of Water Not Subject to Marked Change in Stage From Water-Supply Withdrawals

By Charles W. Sherman
*Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.*

WATER supplies which do not cause marked changes in stage of the source from which they are taken may be somewhat arbitrarily classed as surface supplies to differentiate them from underground and stored supplies. Rivers and lakes are sources for such surface supplies. If the water is taken from a river, the lowest flow of the stream must be materially greater than the maximum demand for water supply; if from a lake, the water-supply draft must not affect the water level materially, otherwise the lake becomes in effect a storage reservoir.

### River Supplies

Any stream in which the minimum flow exceeds the maximum demand for the supply of a community of any size must receive the runoff from a very considerable area. It is consequently certain to be more or less polluted by the wash from streets and from cultivated areas; and the probability of its containing sewage effluents and manufacturing wastes is considerable. It is essential that the amount of pollution should not be in excess of the load which may be put upon the water-treatment plant. Further, the quantity of water remaining in the stream after the abstraction of the water supply must be adequate for proper dilution of all wastes entering it, including the wastes from the city for which the water is taken.

**All sources of water supply fall into two great classes, surface and underground. Surface supplies are again divided broadly into those ample for all needs without storage to meet seasonal and longer periods of low flow and those that are not. Problems incident to surface waters not requiring storage are outlined by Mr. Sherman in the following article, while on other pages Ezra B. Whitman deals with impounded supplies.**
**—*Editor.***

Obviously, the ideal water supply should be obtained from an unpolluted source, and where this can be done it will be better in the great majority of cases to develop relatively clean waters, even at considerably greater cost, than to depend upon rivers close at hand, notwithstanding the possibility that the river water after treatment may be equally good from a sanitary point of view. In the recent case of Connecticut vs. Massachusetts, experts for Massachusetts testified that the quality of the water in the Merrimac River is such that, although it could be made safe by treatment, there was danger of interruption to the process, and that a supply which would be safe all the time could not be obtained from that stream. Moreover, the city of Lawrence, which uses filtered water from that stream, is far from satisfied with its supply.

In many cases, however, waters free from pollution cannot be obtained in sufficient quantity and it is necessary to make use of those which are available. Most of the large cities situated upon the Ohio, Mississippi and Missouri rivers have no option, but must use the waters of those streams or of their major tributaries. It then becomes of great importance to take the water at such a point as to obtain not only an adequate quantity but the best quality of raw water obtainable. Extensive investigations may be necessary, therefore, before fixing the point at which the water shall be taken. These should include soundings, locations of currents at various stages of water, presence of streams or areas of polluted water and location of sludge banks which might be scoured out and cause pollution of the water at times of flood.

*River Intakes*—In a few cases, particularly in large rivers subject to wide fluctuations in stage, intake towers have been found advantageous. More frequently, however, submerged cribs or open-ended pipes are used, and occasionally an intake structure at the riverbank is practicable and advantageous. Various types of intakes are described in considerable detail in a paper by Charles B. Burdick in *Engineering News-Record*, May 22, 1930, p. 834. In general it is desirable to locate the intake in as deep water as practicable, and it is necessary to adopt a location which will receive an adequate supply of water when the river is at a low stage. Conditions of currents carrying silt or polluted matter, likelihood of the bottom to erosion, requirements of navigation and many other factors must be given due consideration, and no criterion of general applicability can be stated.

### Lake Supplies

There are a few instances of cities obtaining water supplies from near-by lakes which are substantially free from pollution, and where chlorination, alone or in combination with sanitary control of a limited portion of the lake in the vicinity of the intake, is sufficient to insure the quality of the water. The supply of Portland, Me., from Sebago Lake, is an instance. Here the size of the lake and its drainage area are such that control of storage is not required. The population on the drainage area, and even including the summer colonists along the shore, is so insignificant as to offer no menace as long as the water is properly chlorinated. In such a case the provision of a proper intake is the only problem of consequence.

There are other cases, such as that of Rochester, N. Y., where the water supply should properly be considered as impounded, even though the source be a lake of considerable size. The draft of water is so large in proportion to the size of the lake and its drainage area

that the control of storage is essential. Also, the presence of an appreciable population around the lake shores makes it necessary to exercise constant supervision for the prevention of pollution and for the city to acquire a considerable amount of the shore as a protective measure, with the possibility that filtration as well as chlorination may become necessary unless the increasing tendency to use the shore and the waters for recreational purposes is checked. The problems in such a case are essentially those of an impounded supply and will not be considered further in this discussion.

The ordinary lake supply is typified by those of the cities on the shores of the Great Lakes. Here the quantity of water available is practically unlimited. Fluctuation of water level is very gradual, although it may be considerable over a term of years. The lake necessarily receives the sewage or sewage effluent of the cities along its shores and upon its tributary streams, as well as surface wash, and the effect of winds and waves in stirring up deposits on the bottom and along the shores is likely to be considerable. Few, if any, supplies obtained under such conditions are satisfactory for use without filtration, although several are in use where chlorination alone is depended upon to protect the sanitary quality.

Assuming that the water is to receive proper treatment, the problem of obtaining a suitable supply involves the location, design and construction of a proper intake.

*Lake Intakes*—In general, the intake proper consists of a crib of some type, generally submerged and rising but a short distance above the lake bottom, although in large works it may extend above the water surface and include a lighthouse and living quarters for attendants. It must be far enough from shore to avoid turbidity caused by waves, and to reduce to a minimum the danger of pollution from surface wash and sewage discharges; it must be in deep enough water to minimize trouble from ice; and it must be so located as to avoid currents of polluted water as well as to be out of the usual course of navigation. The methods used by Alvord, Eddy and Whipple to study the currents induced by winds and their effect in carrying polluting materials from the sewer outfall to the vicinity of the water intake at Milwaukee are described in "American Sewerage Practice," Vol. III.

The intake conduit may be a tunnel under the bed of the lake, or it may be a pipe laid in a dredged trench or directly upon the bottom, except where the depth is so slight that it is necessary to bury the pipe to protect it from damage by ice or by waves. Typical intake structures for various conditions are illustrated in Mr. Burdick's article referred to above.

In fixing the location of an intake, it is usually desirable to go into as deep water as can be reached at reasonable expense. The effect of waves may be felt to depths as great as 40 ft. in the Great Lakes, and probably to 20 ft. in any lake large enough for use without the control of storage. It is desirable, therefore, to locate the intake at not less than 20 ft. below the surface, and 30 ft. or more is better if practicable. The danger of trouble from ice is also greatly reduced if the depth of the intake is considerable.

In the case of submerged intake cribs, to which access can be had only by a diver, it is of great importance that the velocity through the ports be kept very low, in order to avoid clogging by ice and by waterclogged pieces of wood, as well as to reduce the likelihood of fish being drawn into the intake. Screens or racks should not be used on submerged intakes. Open-end pipes should be flared, or branches provided so that several openings, each of the full diameter of the pipe, will be available. While there are cases in which velocities of 0.25 ft. per second or more through the ports have prevailed and no trouble has been experienced, it seems wiser to plan for velocities of approximately half this amount.

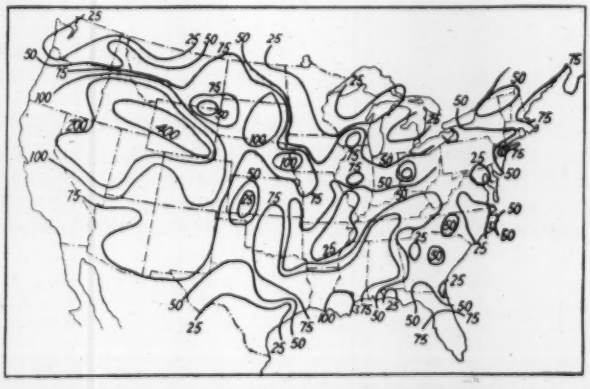
In the case of large intake cribs extending to the surface, higher velocities through the ports are common—something like 1½ ft. per second at times. Constant attendance, however, is necessary to guard against blocking the openings in such cases.

*Racks and Screens*—Neither racks nor screens should be provided over the ports of an intake unless they are readily accessible for cleaning, and in that event they should be designed so that efficient cleaning can be done without great difficulty. In the case of a river intake located at the bank of a stream, a coarse rack similar to those used at the entrance to power plant penstocks is desirable as a first line of defense, followed by some type of fine screen which can be cleaned without difficulty. Where intakes are located in deep water or are of the submerged type, there should be a screen chamber at the shore end of the intake conduit where fish, roots, filamentous plants, waterlogged sticks and any similar materials can be removed before the water reaches the pumps. Many significant comments upon intake screens are contained in a recent paper presented to the Pacific Northwest Section of the American Water Works Association by J. W. Cunningham.

# Drought Records Are Important to Flow Estimates

By Kendall K. Hoyt
*Washington Office, Engineering News-Record*

ENGINEERS of the future will view the great drought of 1930 with more than academic interest, for it is the most severe dry period so far in American history. Duration is its most outstanding feature. Record low flows are now being reached on many streams; they would be less serious if they hung on for only a few days, but on watersheds developed to take most of the average yield a long-continued shortage means that communities or power plants will be hard pressed for supply. Figures from the 1930 drought unquestionably will determine future water-supply reservoir capacities, as these must be large enough to survive all dry weather. To supply the basic data for present and future develop-



PERCENTAGE OF NORMAL PRECIPITATION FOR AUGUST, 1930
Based on reports from first-order Weather Bureau stations, prepared by J. B. Kincer, of the bureau.

COMPARISON OF 1930 DROUGHT WITH SIX OTHERS

Percentage of Normal Precipitation

| | 1930 | | | | 1861 | | | | 1894 | | | | 1901 | | | | 1911 | | | | 1916 | | | | 1924 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | March to May | June | July | Aug.* | March to May | June | July | Aug. | March to May | June | July | Aug. | March to May | June | July | Aug. | March to May | June | July | Aug. | March to May | June | July | Aug. | March to May | June | July | Aug. |
| Md. | 64 | 85 | 32 | 22 | 79 | 182 | 54 | 26 | 110 | 60 | 61 | 63 | 128 | 79 | 123 | 135 | 64 | 105 | 61 | 230 | 98 | 151 | 125 | 51 | 153 | 136 | 57 | 95 |
| Va. | 61 | 74 | 38 | 45 | 68 | 74 | 74 | 27 | 72 | 46 | 89 | 76 | 138 | 108 | 104 | 198 | 80 | 83 | 68 | 136 | 79 | 135 | 121 | 73 | 137 | 107 | 77 | 98 |
| W. Va. | 64 | 64 | 41 | 50 | 89 | 131 | 90 | 30 | 84 | 73 | 48 | 52 | 144 | 126 | 70 | 127 | 80 | 98 | 61 | 167 | 102 | 120 | 76 | 120 | 140 | 104 | 98 | 115 |
| Ky. | 51 | 45 | 30 | 50 | 73 | 123 | 49 | 33 | 77 | 68 | 49 | 81 | 80 | 10 | 41 | 138 | 95 | 102 | 56 | 108 | 79 | 122 | 102 | 113 | 98 | 110 | 88 | 81 |
| Ohio | 64 | 58 | 41 | 42 | 78 | 147 | 95 | 34 | 82 | 65 | 41 | 52 | 96 | 110 | 69 | 100 | 81 | 97 | 62 | 164 | 104 | 122 | 49 | 94 | 99 | 160 | 72 | 94 |
| Ind. | 63 | 68 | 53 | 34 | 85 | 134 | 38 | 33 | 90 | 68 | 41 | 55 | 64 | 116 | 38 | 94 | 87 | 100 | 50 | 97 | 84 | 174 | 71 | 97 | 96 | 163 | 56 | 112 |
| Ill. | 57 | 87 | 30 | 49 | 83 | 123 | 88 | 62 | 84 | 59 | 45 | 53 | 66 | 85 | 73 | 53 | 82 | 72 | 70 | 124 | 77 | 141 | 36 | 120 | 78 | 174 | 100 | 110 |
| Mo. | 59 | 79 | 24 | 66 | 80 | 114 | 38 | 44 | 88 | 80 | 62 | 42 | 70 | 43 | 50 | 50 | 73 | 37 | 100 | 110 | 98 | 143 | 30 | 105 | 82 | 151 | 135 | 108 |
| Ark. | 94 | 21 | 20 | 15 | 92 | 105 | 37 | 22 | 133 | 33 | 105 | 124 | 79 | 33 | 66 | 81 | 90 | 58 | 126 | 222 | 62 | 121 | 55 | 70 | 88 | 84 | 63 | 62 |
| Tenn. | 86 | 32 | 54 | 60 | 89 | 100 | 36 | 44 | 81 | 55 | 93 | 93 | 91 | 70 | 45 | 239 | 96 | 86 | 109 | 110 | 79 | 127 | 166 | 119 | 97 | 77 | 86 | 59 |
| Ala. | 77 | 47 | 74 | 75 | 111 | 79 | 33 | 147 | 76 | 51 | 93 | 153 | 118 | 65 | 63 | 189 | 92 | 91 | 106 | 111 | 74 | 79 | 310 | 80 | 93 | 125 | 67 | 64 |
| Miss. | 96 | 16 | 50 | 80 | 83 | 54 | 38 | 80 | 84 | 55 | 116 | 134 | 80 | 52 | 80 | 159 | 94 | 102 | 128 | 145 | 92 | 93 | 204 | 82 | 91 | 80 | 34 | 41 |
| La. | 79 | 12 | 60 | 70 | 71 | 23 | 56 | 43 | 100 | 88 | 98 | 125 | 80 | 63 | 114 | 106 | 95 | 96 | 151 | 154 | 95 | 81 | 129 | 87 | 92 | 62 | 24 | 44 |
| Tex. | 99 | 64 | 42 | 50 | 102 | 9 | 81 | 73 | 107 | 79 | 81 | 200 | 76 | 39 | 96 | 62 | 102 | 27 | 142 | 81 | 87 | 67 | 104 | 104 | 100 | 64 | 35 | 50 |
| Okla. | 95 | 97 | 32 | 90 | 98 | 21 | 181 | 53 | 101 | 42 | 55 | 50 | 96 | 53 | 61 | 53 | 59 | 29 | 171 | 124 | 73 | 174 | 26 | 40 | 95 | 90 | 94 | 80 |
| Kansas | 94 | 59 | 95 | 75 | 114 | 73 | 85 | 63 | 69 | 144 | 39 | 23 | 86 | 68 | 44 | 84 | 61 | 18 | 98 | 116 | 86 | 177 | 20 | 68 | 86 | 65 | 90 | 132 |
| Nebr. | 130 | 84 | 44 | 99 | 159 | 134 | 85 | 54 | 54 | 84 | 41 | 25 | 86 | 118 | 47 | 79 | 75 | 47 | 88 | 125 | 76 | 90 | 53 | 125 | 61 | 113 | 112 | 79 |
| Iowa | 78 | 129 | 39 | 50 | 84 | 164 | 139 | 79 | 74 | 60 | 16 | 47 | 72 | 82 | 60 | 38 | 83 | 40 | 60 | 97 | 97 | 82 | 47 | 76 | 61 | 180 | 98 | 159 |
| S. Dak. | 90 | 74 | 37 | 90 | 121 | 86 | 93 | 127 | 102 | 83 | 33 | 55 | 69 | 183 | 67 | 114 | 63 | 51 | 78 | 155 | 113 | 103 | 89 | 150 | 56 | 140 | 63 | 109 |
| N. Dak. | 81 | 89 | 42 | 68 | 77 | 109 | 38 | 104 | 125 | 77 | 23 | 48 | 46 | 174 | 166 | 78 | 92 | 89 | 69 | 156 | 106 | 112 | 123 | 122 | 79 | 120 | 77 | 70 |
| Mont. | 84 | 57 | 68 | 58 | ... | ... | ... | ... | ... | ... | ... | ... | 114 | 112 | 67 | 42 | 104 | 112 | 67 | 150 | 95 | 154 | 47 | 100 | 65 | 107 | 74 | 84 |
| Minn. | 88 | 95 | 71 | 20 | 81 | 88 | 49 | 154 | 148 | 64 | 20 | 40 | 74 | 142 | 95 | 67 | 93 | 93 | 103 | 131 | 133 | 120 | 80 | 113 | 87 | 106 | 80 | 149 |
| Wis. | 83 | 136 | 70 | 25 | 101 | 103 | 157 | 91 | 133 | 83 | 25 | 25 | 72 | 108 | 117 | 52 | 92 | 88 | 103 | 116 | 108 | 157 | 44 | 94 | 116 | 108 | 98 | 222 |
| Mich. | 84 | 106 | 46 | 25 | 90 | 155 | 97 | 75 | 133 | 90 | 46 | 18 | 83 | 81 | 140 | 91 | 92 | 100 | 94 | 97 | 122 | 155 | 40 | 90 | 95 | 78 | 117 | 129 |
| Pa. | 80 | 102 | 50 | 40 | 81 | 171 | 50 | 40 | 130 | 64 | 53 | 43 | 139 | 86 | 89 | 162 | 77 | 115 | 64 | 181 | 100 | 149 | 100 | 62 | 117 | 137 | 78 | 91 |
| N. J. | 68 | 114 | 87 | 60 | 97 | 153 | 42 | 24 | 113 | 63 | 37 | 55 | 148 | 44 | 129 | 196 | 80 | 146 | 79 | 178 | 92 | 114 | 118 | 26 | 129 | 114 | 57 | 88 |
| N. Y. | 97 | 116 | 77 | 47 | 86 | 97 | 62 | 40 | 105 | 93 | 67 | 43 | 145 | 93 | 112 | 135 | 72 | 110 | 72 | 122 | 114 | 128 | 85 | 58 | 108 | 76 | 88 | 95 |

* Data for August, 1930, based on daily telegraphic reports of first order stations up to and including Aug. 29, and subject to revision.

ments, the water resources branch of the U. S. Geological Survey will begin soon to prepare a detailed report comparing 1930 lows and durations with past records. Some of these data are given in the accompanying table.

*Present Aspect of the Drought*—Indications are that the drought is beginning to break. However, during August, as shown by the accompanying rainfall map, the already unprecedented precipitation deficiency not only continued in most areas east of the Rockies but spread into regions formerly in fair shape: Minnesota, Wisconsin, Michigan and the Southeastern states. (Compare with maps published Aug. 14, p. 259, and further data Aug. 28, p. 343.)

Streamflow conditions have not changed greatly since the earlier reports. Aside from regions in which rainfall recovery occurred, discharges declined steadily but very gradually. Taken as an example, the Potomac River, in one of the worst parts of the drought area, fluctuated up and down in June, dropped rapidly through July, and held fairly constant through August at a stage close to the record minimum. Available records of measured wells near by indicate that groundwater stood at approximately the same level at the start of this season as at the maximum in the spring of 1929. There has been nearly a straight-line decline all summer. The present level is but slightly lower than last year and by no means abnormal in the light of past records.

This summer's streamflow has given an index of runoff from groundwater somewhat independent of the varying influence of rain. In the Potomac basin the marked differences between unit runoff in tributary areas suggest further variables relating to groundwater storage and underflow.

## Two-Compartment Water Tank Cleaned While in Service

The reinforced-concrete water tank of 240,000-gal. capacity at Hertford, England, referred to in *Engineering News-Record* of June 12, 1930, p. 967, has its interior divided into two approximately equal portions to allow continuity of service during cleaning. One half of the tank can be cleaned while the other half remains in operation to supply the district with water.

# Los Angeles Water Demand Hastens Aqueduct Extensions

*Special Correspondence*

DURING the summer months just past Los Angeles actually has consumed daily twice the volume of water delivered through the Owens Valley aqueduct. With a wise appreciation of this situation Los Angeles voters on May 20 approved a bond issue of $38,800,000 (*Engineering News-Record*, May 29, 1930, p. 909) for extension and improvement of its existing water-supply system. The city is now engaged in extracting the last drop of water, practically speaking, from the sources tributary to the Owens Valley aqueduct. These developments in nowise affect the plan for bringing in a water supply from the Colorado River—the ultimate supply to be derived from the Owens Valley aqueduct will be needed urgently before the Colorado River water could be brought in even though work on the latter project starts promptly.

The largest item in increasing the present water supply is the flow to be diverted into the Owens Valley basin from Mono basin, utilizing water rights to be purchased from the Southern Sierras Power Co. Three alternate routes for bringing in this additional supply are now being investigated. Two involve tunnels about 11 miles long. On both of these tunnels it is probable that three shafts (the maximum depth being 835 ft.) would be used to expedite driving. Core drilling is now being done at the several shaft locations. The driving time for the long tunnels is estimated at less than two years exclusive of shaft-driving time. The third route is at lower level and does not involve long tunnels. Selection of the best route probably will be made in late November or early December.

As originally planned, the Owens Valley aqueduct was designed for a maximum flow of 400 sec.-ft. That was based on the value 0.014 for $n$ in Kutter's formula. It is now believed that this value of $n$ can be reduced materially, perhaps as low as 0.0125, by lining some of the tunnels and canals. This work is not required on the entire aqueduct, as some of the tunnels and siphons

were built with a capacity of 500 sec.-ft. Improvement of conduit surface should increase the capacity to 440 sec.-ft. and perhaps to as much as 470 or 480 sec.-ft. In the recent bond issue $600,000 was included for this work.

The surfacing will necessitate unwatering the aqueduct, which is impracticable during the high summer demand. It is therefore planned to carry on the work during the winter season in three consecutive years. Each winter five shutdowns of about ten days each are to be scheduled at intervals that will impose minimum interference. The controlling factor in winter will be maintaining storage in Fairmount reservoir sufficient to permit of continuous operation of the power plants located below. Although the aqueduct was originally designed for 400 sec.-ft., experience of the past few years has demonstrated that not more than about 300 sec.-ft. can be relied upon from present sources. Hence the importance of bringing in the Mono supply, which is expected to yield a minimum of 130 to 140 sec.-ft. During the past summer as much as 256 sec.-ft. was being pumped at one time from wells in Owens Valley.

Studies are also being made by the water department with a view to extending the storage capacity in Los Angeles, developing underground storage basins and making use of all desirable supplies pumped from wells.

# Letters to the Editor

## *A Forum for Expression of Views by Engineers and Contractors*

### *Membership Qualifications*

Sir—The board of direction of the American Society of Civil Engineers has circularized the members concerning a proposed amendment to the constitution. One of the changes proposed is in the matter of membership qualifications. The board conducted a preliminary questionnaire among the members to which about three-eighths of the total roster responded—a proportion indicating widespread interest.

The results of the questionnaire showed that 42 per cent of the members answering the questionnaire favored "adding the word 'conceive' to the word 'design' as now used," against 55 per cent who favor retaining the word "design" as at present. The committee board has apparently taken this as justifying the proposed new wording of Section 2, in *Article II—Membership*, which reads:

> 2—A Member, at the time of his admission, shall be qualified not only to direct but also to conceive or design engineering works.

Is the idea here that the Member should be qualified to conceive *or* design engineering works, or should he be able to conceive *and* design engineering works? On first reading the proposal as stated in the questionnaire it seemed of little importance to add the word "conceive," but harmless enough. The question might be asked, how can the "conceiving" ability of a candidate for membership be determined? Or measured? It differs materially from the ability to "design and direct." The latter is generally shown by the candidate's record of actual performance.

To make the ability simply to conceive engineering works alternative with that of designing, as implied in the use of the word "or," weakens seriously the qualifications as they now stand. Many business men can conceive engineering works and even carry that conception to the point of determining approximately how much money is needed to carry them out. Such are not civil engineers, however, nor would they expect to be so rated. C. J. TILDEN.

Yale University,
New Haven, Conn.,
Aug. 29, 1930.

### *Hydraulic-Fill Levee Construction on the Mississippi*

Sir—I quite agree with your editorials and Mr. Willbanks' articles on hydraulic-fill levee construction on the Mississippi River levees in the July 17 and 24 issues of the *Engineering News-Record* that the hydraulic dredge is an excellent levee-building tool. Also that it would be more so could certain changes be made in the levee specifications so they would be more suitable for hydraulic-fill levee construction.

The following suggestions have probably already been studied and some of them no doubt tried out on the river, but as new equipment in the cheaply operated diesel dredges is now available, together with proved methods of high and narrow hydraulic-fill construction for highways, it is hoped that a review will be of interest.

A levee section having a 40- to 60-ft. top or crown and perhaps slightly steeper side slopes than the present levees is suggested for consideration. This section would contain more yardage than the present section, thereby making it a safer levee. The unit price per yard of material pumped into this levee would be considerably less for the reason that larger dredges could be used to better advantage than on the present section, with greatly reduced shore line delays, as two pipe lines and valves could be used. The wide crown would permit building a roadway on top of the levee, allowing vehicle travel along the river. During high-water emergencies the roadway would provide quick transportation facilities for men and equipment to the threatened areas. The larger levee section would also provide the material for raising the levee should such an emergency be necessary.

Hydraulic-dredge fills for highways, bridge approaches, etc., are now quite often without difficulty made to elevations of 20 to 30 ft. with steeper slopes than on the river levees. The retaining dikes are put up in the usual way with dragline machines, or flashboards are used. The 18- to 20-in. dredges appear to be the most satisfactory plant for this work, although both larger and smaller dredges are used depending on the length of pipe line and the contractor's available equipment.

Therefore it would seem that the 15-, 18- and 20-in. dredges would be best suited for levee-building purposes, particularly if a more suitable levee section for hydraulic fill is adopted. With the larger dredges a better selection can be made of the material for the levee, the dredge being able to pump from a greater distance. The retaining dikes will not give any more trouble with the larger dredges if properly constructed and with the dikes built farther ahead there should be little if any greater loss of material over the spillways than with the smaller dredges.

Mr. Willbanks in his article shows the retaining dikes built up by dragline machines taking the material from borrowpits outside the levee. By taking the material from one borrowpit at about the center of the proposed levee location this pit would form a core for the levee on the principle of hydraulic-fill dam construction. The dragline machines would require less moving around than with the two borrowpits during the building of the retaining dikes. The best material in the pit could be selected for the river-side dike. With a central borrowpit a clamshell derrick in a flooded pit could be used and in locations with soft and swampy ground or where sloughs or bayous have to be crossed the clamshell derrick should be able to build the retaining dikes considerably cheaper than the dragline machine.

O. P. ERICKSON,
Engineer,
Great Lakes Dredge & Dock Co.,
Chicago, Ill.

Toledo, Ohio,
Aug. 21, 1930.

# News of the Week

## New Arkansas State Highway Bridge Span Dynamited

Early on the morning of Sept. 3, several heavy explosions wrecked the middle span of the new Red River toll bridge at Garland City, Ark., by dropping it 75 ft. from the piers into 23 ft. of water. The structure, consisting of three 303-ft. through spans and about 900 ft. of concrete deck girder approaches, had been built for the Arkansas state highway commission by the Kansas City Bridge Co., and Ira G. Hedrick, Inc., of Hot Springs National Park, Ark., was the consulting engineer. Work on the bridge had been completed and J. E. Hayes, superintendent for the contractor, had shipped out all of his equipment and was cleaning up in preparation for a final inspection and formal acceptance. As yet no definite knowledge of the motive for the crime or of the persons committing it has been announced. One theory is that racketeering structural steel workers are responsible. The contractor was using open-shop labor.

### Two Charges Exploded

Apparently a charge of nitroglycerine was set off in each of the shoes of the center span, dropping it into the river between the piers and totally wrecking it. Eyewitnesses on the ferry, about 500 ft. upstream, say the east end (right) was exploded first, but did not throw the span. Two minutes later the west end was exploded and the whole span was thrown into the air.

According to J. G. Meyers, resident engineer for Ira G. Hedrick, Inc., the first two panels of the west end of the east span, at which the first explosion occurred, were damaged so that the end floorbeam and the batter post and bottom chords will have to be replaced. The east end of the west span was not so seriously injured, the shoes and pin plates only having to be replaced. The two remaining spans showed no lateral or longitudinal displacement, but the ends over the blasted piers settled several inches when the shoes were blown out. The two center piers, over which the charges were placed, are chipped and shattered for about 2 ft. down from the top, but are otherwise uninjured.

The bridge had not been formally accepted by the Arkansas state highway commission from the contractors, although advance payments as provided by the contract award have been made during the past several months. These payments amount to nearly $395,000.

Work on the bridge has been interrupted at different times by court litigation, the most recent delay being encountered last July, when the contractor was forced to abandon construction operations pending settlement of a dispute between town officials at Garland City and highway authorities over the construction of fills through the village. This dispute was settled amicably. Since then the work has continued without interruption.

The bridge was started in October, 1929 and is located about 25 miles east of Texarkana. The cost of the completed job was about $500,000 and it is estimated that removing the old span and rebuilding will cost about $200,000.

WRECKAGE OF 303-FT. CENTER SPAN OF RED RIVER BRIDGE IN SOUTHWEST ARKANSAS

## Increased Freight Rates on Cast-Iron Pipe Are Protested

PROTESTING against increased freight rates on cast-iron pressure pipe, A. V. Ruggles, representing the American Water Works Association, testified at an Interstate Commerce Commission hearing in Washington Sept. 4 that higher freight charges effective March 20 this year have thrust a further burden on water-works, in which pipe represents 50 per cent of the capital investment. Called upon to meet constantly higher standards of water purity and water softness and to establish greater volume and pressure for fire fighting, Mr. Ruggles stated, both public and privately owned water-works deplore any increase in the freight rates on an article on which they spend more than they spend on anything else. The new rate scales placing cast-iron pipe on the same rate basis as other iron and steel articles at 22½ per cent of first class would, he said, make it still more difficult for water-works to operate efficiently without increasing their rates to consumers.

### Rates Declared Excessive

The hearing was held before Examiner Wilson on complaint filed by James B. Clow & Sons and the U. S. Pipe & Foundry Co. in which the present rates on pressure pipe from the Northern foundries to destinations throughout official classification territory are declared to be excessive. In general, the rates based on the mileage scales prescribed by the commission in Part 6 of the Hoch-Smith rate structure investigation represent an increase of 10 to 24 per cent. The differential under the Birmingham district that the Northern foundries negotiated in 1923 has been wiped out, leaving them, according to testimony adduced at the hearing, in a precarious competitive position. The complainants seek a reduction to a reasonable level in rates to destinations in official territory and restoration of the old differential under the Birmingham district, which ranged from $2 to $8 and probably averaged $4 to $5 per ton.

Of the total production of pressure pipe 70 per cent is manufactured south of the Ohio River, largely in the Alabama-Tennessee district, and N. F. S. Russell, president of U. S. Pipe, expressed the belief that unless the differential adjustment is restored it will eventually mean moving the entire cast-iron pipe industry to the Birmingham district.

### Carload Minimum Weight Protested

Besides assailing the rates based on the distance scales prescribed by the commission, the pipe foundries also protest against the increase in the carload minimum weight on pressure pipe from 30,000 lb. in straight carloads and 36,000 lb. in mixed carloads with fittings to a uniform minimum of 40,000 lb. The 40,000-lb. minimum is declared to be too high, because in certain sizes the pipe cannot be loaded up to that figure in cars ordinarily supplied by the railroads. The increase in the carload minimum also is objected to as ignoring commercial conditions in the industry.

The railroads defended the uniform rate level established by the commission's order in the Hoch-Smith investigation and pointed out that in the Krupp case, involving the relationship of rates from foundries at Quakertown and Lansdale, Pa., and Florence, N. J., and from Birmingham and Chattanooga, U. S. Pipe had opposed any increase in the rates from Birmingham on the ground that the business would go to Northern mills.

## Three Hydro-Electric Developments Planned in Missouri

Plans and estimates for three large hydro-electric developments at a total cost of $47,340,000 by the White River Power Co. in the White River region of Arkansas have been filed with the county clerk of Baxter County, Mo. The filing was made in connection with the power company's application for a state permit for construction of the three dams on the White River and its tributaries, the North Fork and Buffalo River.

## Bids Opened for Section of Philadelphia Rapid Transit

The Philadelphia department of city transit on Sept. 5 opened bids for relocating the Market St. high-speed line from 24th to 30th St. Eleven bids were received, the lowest being $3,692,635, submitted by the Dravo Contracting Co., of Pittsburgh. The highest bid was $7,767,852, from Patrick J. McGovern, Inc., of New York. Other bids were $3,989,682.50, from the Arundel Corp., of Baltimore, and $4,654,005, from Silas Mason, of Philadelphia. The city engineers' estimate was about $5,000,000 and $7,000,000 was appropriated by the city council. Award of the contract will be made soon, and the contractor must guarantee completion of the job within 27 months.

The new subway extension will be 1,426 ft. long. It will have four tracks. Building of new tunnel carrying the tracks under the Schuylkill River, demolition of the Market St. elevated bridge and construction of a temporary wooden bridge with a 40-ft. roadway and 10-ft. sidewalk south of the present bridge are included in the project, as is also the construction of a temporary bridge over the Schuylkill River at Market St.

Under the terms of the contract, the successful bidder guarantees the work will not interfere in any manner with present subway-elevated traffic.

The tube will be sunk to a maximum depth of 70 ft. below the high water mark of the Schuylkill River. The work will be carried on concurrently with the Pennsylvania Railroad's West Philadelphia Terminal improvements.

## Washington, Ind., May Condemn and Purchase Water-Works

Steps looking toward the purchase of the plant of the Indiana Water Works Co. which supplies water service to the community, have been started by the city council of Washington, Ind. Mayor John W. McCarty has been authorized to name a committee to confer with the public service commission relative to the purchase of the plant. The commission will be asked to condemn the water-works for sales purposes and fix a purchase price. Owners of the water-works recently notified the city that the plant is not for sale.

# *Brief News*

BIDS WILL BE ASKED soon for the construction of a new filtration plant at Brownsville, Tex., to cost from $125,000 to $150,000. It is planned to start construction immediately after the contract is awarded.

THE OFFER of the Union Electric Co., of St. Louis, Mo., to pay to Benton County $200,000 as remuneration for road damages caused by the overflow of land adjacent to the Osage River because of the lake formed by the construction of the Bagnell dam has been accepted by the county court.

OWNERS OF PROPERTY in the first fire district of Providence have been notified to have the roofs of their buildings covered with non-inflammable roofing by Oct. 1, 1931, when the roofing law passed ten years ago becomes effective. Many roofs in this district are now of wood. Outlying sections of the city will not be affected by the law until 1936.

FISHERY INTERESTS of British Columbia have registered vigorous objection to the Northern B. C. Power Co.'s plans for the development of the Meziadin River. Fishery industrials declare the project would destroy 75 per cent of the whole of the Naas River system, a famous sockeye spawning ground. The provincial water comptroller has given fishery interests six weeks to file additional data.

## Arkansas Highway Commission Awards First Cement Contract

On Aug. 29 the Arkansas state highway commission awarded a contract for 100,000 bbl. of cement to the Okay Cement Co., Okay, Ark. The highway department will, for the first time, furnish all cement to contractors for highway construction. The contract will run from one year commencing Sept. 15. Cement will be delivered to about twenty distributing points throughout the state as required by the commission.

## Water Projects in Washington

The utilities committee of the city council of Seattle, Wash., has approved an ordinance appropriating $2,000,000 for a new aqueduct for the city water department to run from the new control works at the end of Lake Youngs to Seattle.

Within 60 days work will begin on the construction of a reservoir of 80,000,000-gal. capacity in West Seattle, to cost $650,000, under plans completed by R. H. Thomson, city engineer.

A citizens' committee, named to investigate the feasibility of a municipal water system in Mount Vernon, Wash., recommends that such a system be established and estimates the cost to be $258,925. Plans recommended by the committee provide for pipe installation costing $127,000, a 2,000,000-gal. filter plant and sedimentation basin costing $40,000, and a $30,000 reservoir.

*Wide World Photo*

**DIABLO DAM, NEAR SEATTLE, DEDICATED**

**Diablo dam, Seattle, Wash., municipal hydro-electric power project on the Skagit River in Washington, 100 miles northeast of the city, was dedicated on Aug. 27. This dam, situated in a narrow gorge 200 ft. deep, rises 389 ft. above bedrock and creates a reservoir of 90,000 acre-ft. extending 6 miles upstream to the site of the proposed Ruby dam. The initial power plant installation will provide 167,000 hp. of the ultimate 225,000 hp. contemplated. The dam was constructed by the Winston Bros. Co., Minneapolis. A description of the project was given Aug. 29, 1929, p. 320.**

## Detroit Airport Dedicated

Dedication of the new Wayne County airport at Detroit, Mich., took place on Sept. 4. This airport was designed and built for the stimulation of commercial flying. There are four concrete runways, 9 in. thick and 100 ft. wide, reinforced with steel mesh.

The size of the main hangar building is 434x128 ft., on the second floor of which is a parachute packing room, a parachute drying shed, a small restaurant, a public lounge and a pilots' room with lavoratories and showers. Above the second floor is a glass-inclosed tower at each end, one for the U. S. Weather Bureau and the other, at the field end, for the operator's office. The hangar proper has two openings, 157 ft. on each side with a clearance of 24 ft., while at each end of the hangar is a 90-ft. opening with a 22-ft. clearance. Besides this there is a military hangar, 110x135 ft., which has, in addition to hangar proper, offices, bedrooms, two classrooms, a parachute room and an observation tower.

The airport is as well adapted to night flying as to day flying. It was constructed under the direction of the board of county road commissioners.

## Sacandaga Reservoir to Be Dedicated Sept. 11

The Sacandaga reservoir, created by impounding of water by the Conklingville dam, will be dedicated on the afternoon of Sept. 11. The dam and reservoir were built by the Board of Hudson River Regulating District. The reservoir, 27 miles long and covering 42.3 square miles, will have a capacity of 30 billion cubic feet. The dam is 1,000 ft. long and contains 670,000 cu.yd. of earthfill and 120,000 cu.yd. of rockfill. S. J. Groves & Sons, Minneapolis, built the dam under the supervision of Edward H. Sargent, chief engineer, and Albert S. Crane, consulting engineer of the regulating district.

## Fall Meeting, New York State Sewage Works Association

The fall meeting of the New York State Sewage Works Association will take place Sept. 13 at Syracuse. On the program are papers on "Chlorine Uses at Sewerage Plants," by L. H. Enslow; "Stream Pollution From the Operator's Standpoint," by Prof. E. B. Phelps; "Plant Operation and the Health Officer," by George C. Ruhland; "Metal Preservation Above and Below Sewage Surface," by R. S. Rankin; "Garbage Wastes," by John F. Skinner; "Experience With Small Pumping Stations," by Harry W. Eustance; "Pumping of Sewage Sludge," by Irving Nevitt.

There will also be an inspection trip to near-by sewage-treatment works.

C. A. Holmquist, of the state department of health, Albany, is president of the association, and A. S. Bedell, also of the state department of health, is secretary.

## Kenneth Allen, Sanitary Engineer, Dies

Kenneth Allen, sanitary engineer in the department of sanitation, New York City, who had been planning to retire from active service on Oct. 1 on account of ill health, died at his home, White Plains, N. Y., on Sept. 7. Born April 6, 1857, Mr. Allen was graduated from Rensselaer Polytechnic Institute in 1879. He engaged in many branches of civil engineering, until, on entering the service of the Baltimore sewerage commission in 1895, he began definitely to specialize in the field of sewage disposal. His Baltimore work was interrupted by his employment as engineer and superintendent, water department, Atlantic City, N. J., from 1902 to 1906, but he returned to the Baltimore sewerage commission and served from 1906 to 1908. In 1908 he went to New York, where he had since specialized on sewage disposal, at first for the metropolitan sewerage commission, and since 1914 for the city. From 1917 until the organization of the department of sanitation at the beginning of this year he was sanitary engineer of the board of estimate and apportionment.

KENNETH ALLEN

Mr. Allen had been active in the American Society of Civil Engineers, the American Society for Municipal Improvements, the American Public Health Association, the American Society for Public Improvements, the Municipal Engineers of the City of New York, and the New York State Sewage Works Association, of which he was one of the organizers and the first president. He was exceptionally well informed on sewage-disposal plants and methods both in this country and abroad, had unusually wide contacts in the sanitary field and was a frequent contributor to the technical press.

### *The Business Outlook*

**The gradual rise of business activity from the low point reached at the end of July did not continue during the last two weeks of August, and the past week has seen a marked relapse. So far the upturn has been most marked in basic industrial activity rather than in secondary manufacturing activity. Primary distribution and retail trade have begun to show some definite expansion, but general trade remains somewhat slack for the season.**

**These are the decisive days that will determine whether the relatively mild recession so far is to settle into stubborn stagnation or swing into strong recovery.**

***The Business Week, Sept. 10.***

## Fall Meeting of Welding Society in Chicago

Beginning Monday, Sept. 22, and continuing throughout the week, the American Welding Society will hold its fall meeting at the Congress Hotel in Chicago. Numerous items on the program bear on structural welding. The structural steel welding committee will meet at 2 p.m. on Monday. On Tuesday the morning session will be devoted to the subject of welding stainless steels and aluminum. In the afternoon three papers will be given as follows: "The Examination of Welds by the X-Ray Diffraction Method," by J. T. Norton, Massachusetts Institute of Technology; "Fatigue Investigations of Welded Joints," by G. E. Thornton, State College of Washington; and "Stress Distribution in Side-Welded Joints," by Walter H. Weiskopf and Milton Male, being a mathematical study in connection with tests made at the University of Pittsburgh. Wednesday afternoon a symposium on testing of welds will be held with discussions by J. W. Owens, W. B. Miller, Andrew Vogel, C. H. Jennings, R. F. Mehl, G. E. Doan and C. S. Barrett. In conjunction with the meeting a welding exposition will be held in the Stevens Hotel.

## Santo Domingo Almost Destroyed by Tropical Hurricane

Loss of life estimated in the thousands and extensive property damage are reported from the city of Santo Domingo, capital of the Dominican Republic, and near-by territory as the result of a severe hurricane which passed over the city Sept. 3. Preliminary reports state that only 400 of the 10,000 buildings in the city escaped damage. Among the structures reported as destroyed are the bridge over the Ozama River, radio towers and the president's palace; while the ancient cathedral and most of the churches, of unusually heavy construction, are said to have escaped uninjured.

Communication with the interior of the island and with the outside world was practically suspended, the city being isolated by high water in the streams, destroyed bridges and a barge sunk in the channel leading to the port. Electric power plants and water-supply systems are reported out of service.

Unofficial reports state that the area affected by the storm included a 40-mile strip along the coast extending inland in a northwesterly direction for an undetermined distance. The small island of Dominica, a British possession located 450 miles southeast of Santo Domingo, was also affected by the wind, which had an estimated velocity of 150 miles per hour.

## WASHINGTON NOTES

By Paul Wooton
*Washington Correspondent*

### Boulder Dam Work Officially Started—International Road Congress Attracts Many Engineers

BOULDER DAM construction will be officially opened Sept. 17 by a ceremony at the dam site presided over by Ray Lyman Wilbur, secretary of the interior, with members of his staff and Western governors, senators, and other public officials. Without marking an actual turning point in the job, this event is for the purpose of giving due recognition to a project of such size and importance as a national rather than a local undertaking.

Selection of a project townsite has been made, according to an announcement this week by Elwood Mead, commissioner of reclamation. Five possible locations were considered, of which the highest and farthest from the dam was chosen because of its superiority on several counts. The new town will be on a level expanse at the top of a divide overlooking the dam, the reservoir and the mountains beyond. The proposed railroad and highway will pass the town down a draw into the main river valley at the dam. The townsite elevation is 2,500 ft., that of the canyon floor 650 ft. and of the dam crest, 1,232 ft. The dam will be 6 miles from the town. Daily transportation will be by rail.

Lower temperature is an important factor in the choice. It was found that the upper site is 13 deg. F. cooler than the Colorado River Valley at that point and also subject to fresh breezes. Water will be pumped either from the river (later from the reservoir) or from the good artesian supply at Las Vegas, unless nearer artesian sources are discovered. Sewage will run down steep pipes to the river below the dam. Surface drainage is good. There is workable soil and some grass, rareties in that region. Obviously there is no flood problem, as would be encountered in some lower sites.

### Railroad Bids Opened

Bids for the construction of the railroad from Las Vegas to the new town, 17 miles, were opened on Sept. 5 by the Union Pacific Railroad, which will operate this spur line. The Union Pacific participation will save money from the original estimate of $10,660,000 for commencement of the work, as will the arrangements for power during construction. Bids for preliminary power will be opened on Sept. 26. The bureau has estimated the cost of a power house on the job but is getting bids on the basis of delivery from an operating company.

### Many Foreign Delegates to Attend Road Congress

Interest in the forthcoming Sixth International Road Congress has developed to an extent which is surprising even to its sponsors. As many as 500 foreign delegates are expected at the sessions, which will run from Oct. 6 to 11. A total of 60 countries plus the League of Nations, out of 85 nations, colonies and dependencies, are sending delegates. More are virtually assured. In addition to the official representatives, engineers will be sent by local automobile and road associations. A striking feature of the meeting, which indicates a world-wide interest in highway problems, is that men actively engaged in the work of the member nations are being sent to learn and not merely in honorary capacities.

To attract Latin American attendance, Spanish has been added to the three official languages formerly used—English, German and French. As a result almost every Latin American country will be represented. Throughout the world, in fact, only some of the smallest nations have definitely declined. To counteract the difficult language problem and make the technical sessions more than a meaningless formality, the speakers' words will be relayed as fast as they are spoken, through four interpreters. By earphones the various delegates can listen in to the most convenient language. More than half a millon reports giving abstracts of papers have been distributed in the four languages.

## *Society Calendar*

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York City; Pinehurst, N. C., Oct. 27-28.

AMERICAN IRON & STEEL INSTITUTE, New York City; semi-annual meeting, New York City, Oct. 24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; fall meeting, St. Louis, Mo., Oct. 1-3.

AMERICAN WELDING SOCIETY, New York; fall meeting, Chicago, Sept. 22-27.

ASPHALT PAVING CONFERENCE, New York City; ninth annual conference, Memphis, Tenn., Dec. 1-5.

INTERNATIONAL ROAD CONGRESS; Washington, D. C., Oct. 6-11.

NATIONAL SAFETY CONGRESS, Chicago; annual meeting, Pittsburgh, Pa., Sept. 29-Oct. 3.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass., annual convention, Atlantic City, N. J., Sept. 23-26.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, at its annual meeting to be held in Pittsburgh Nov. 17 to 20, will discuss exhaustively the subject of maintenance of detours. It is the contention of contractors that they should be freed of all responsibility in connection with the passage of traffic around road construction.

CENTRAL STATES SECTION, American Water Works Association, will hold its 32d annual convention in Youngstown, Ohio, Sept. 25 and 26. An interesting and instructive program has been provided.

ILLUMINATING ENGINEERING SOCIETY will hold its 24th annual convention Oct. 7 to 10 in Richmond, Va.

TEXAS PUBLIC HEALTH ASSOCIATION will be the name by which the Texas Sanitarians' Short School will be hereafter known. This was decided at a session of the school held at Amarillo, Aug. 26 to 28. Attendance at the session was 186 and Houston was selected as the next annual meeting place. Officers were elected as follows: president, H. K. Read, Houston; first vice-president, Jack Wyatt, Amarillo; second vice-president, T. A. Ward, Beaumont; third vice-president, W. N. Dashiell, Fort Worth; fourth vice-president, Miss Celia Moore, Austin; secretary-treasurer, E. G. Eggert, Austin.

## *Personal Notes*

Ray P. Tarbell has recently become a member of the firm of Robert E. Kinkead, Inc., consulting welding engineers, Cleveland, Ohio. He was formerly Cleveland district sales manager for the Lincoln Electric Co., having entered its employ in 1918.

Lyman E. Bishop, irrigation engineer, formerly of Denver, Colo., who has been in Russia for the past sixteen months engaged on irrigation projects for the Soviet government, has been made head of the department of design, Soviet Turkestan, with headquarters at Taskhent.

Frank H., Charles R. and Charles A. Frainie have formed a partnership under the firm name of Frainie Brothers to take over the contracting business of the firm of Frainie Bros. & Haigley, which has been dissolved, following the death of W. Leo Haigley.

Henry W. Buzzell, of Montreal, Que., has recently become associated with the Dominion Bridge Co., Ltd., Lachine, Que., in the department of structural design. Previously Mr. Buzzell was with Harrington & Cortelyou, consulting engineers, Kansas City, Mo., on the design of bridges.

J. F. Perrine, engineer of public improvements in the borough of Queens, New York City, and advisory engineer in the Queens Planning Commission, has succeeded William Bishop as engineer in charge of the bureau of engineering for sewers. Mr. Bishop will be assigned to supervise construction for the borough of sewer installation work in the field.

E. L. Eriksen, professor of structural engineering at Purdue University, has accepted an appointment to the chair of engineering mechanics at the University of Michigan. He will be succeeded at Purdue by S. C. Hollister, a graduate of the University of Wisconsin with teaching experience at the University of Illinois, but who has recently been engaged in private practice in structural engineering.

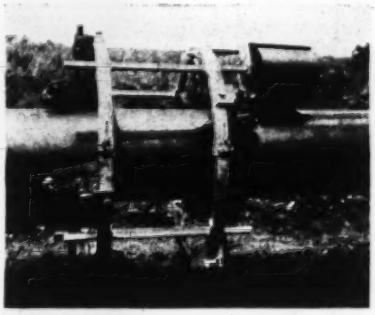
## *Obituary*

Robert Kennedy Russel, of Toronto, civil engineer, marine and railway contractor, died in Toronto on Aug. 31 at the age of 58. Mr. Russell was born at Pembroke, Ont., and was graduated in engineering at the University of Toronto. He was president of the Port Arthur Construction Co., which constructed the harbor of that city, and was also president of the Gordon Development Co., of British Columbia. He constructed 100 miles of the Transcontinental Railway and a similar distance for the Canadian National Railway, also the C.N.R. branch line into the Rouyn mining district. He also carried out the contract for the construction of the Toronto filtration plant.

# Construction Equipment and Materials

## Hand-Operated Machine Wraps Pipe in Field

Application of felt wrapping in the field as a protection against corrosion is the function of a hand-operated pipe-line-wrapping machine developed for

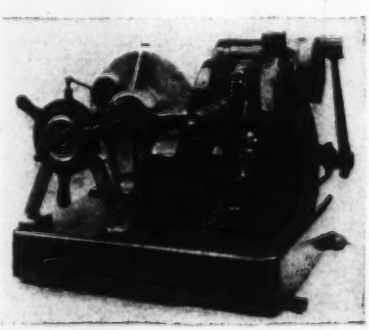


APPLYING FELT WRAPPER TO PIPE

use with all pipe sizes from 4 to 24 in. The device, which is a joint product of the Johns-Manville Corp., New York City, and the W. K. M. Co., Inc., Houston, Tex., carries a roll of felt which is applied so as to give a 1-in. lap. It has a uniform speed of 15 lin.ft. per minute regardless of the size of pipe. Spring-mounted rubber rollers iron out all wrinkles or air spaces which may develop in the felt as it comes from the roll. The machine may be used on either bonded or unbonded jobs without any change in machine or method.

## Pipe-Threading Machine Driven by Gasoline Motor

Threading and cutting pipe on jobs where no electric power is available can be facilitated by the use of a Power Boy threading machine with gasoline engine drive announced by the Oster Manufacturing Co., Cleveland, Ohio. It is claimed that this new combination is just as portable as the regular electric unit, the weight being only a few pounds more. Power is provided by a 1-hp.

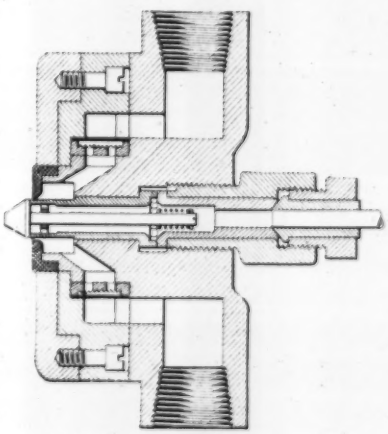


SMALL MOTOR DRIVES PIPE THREADER

single-cylinder air-cooled Briggs & Stratton motor of the four-cycle type equipped with high-tension magneto. This is connected with the cutting apparatus by means of an Eclipse motorcycle clutch and a roller chain drive. An easily operated hand starter is standard equipment. The manufacturers claim that the motor is exceptionally economical, tests showing that it will operate for ten hours on a single gallon of fuel. The machine will thread and cut pipe up to 2 in. in diameter without an auxiliary drive; with the auxiliary, it can be used for sizes up to 4 in.

## Unit Diffuses Large Volumes of Chlorine Gas

Difficulties incident to the application of chlorine gas for the sterilization of water or the disinfection of sewage by the two methods commonly used—dry or solution feed—have been minimized by the Paradon Mfg. Co., Arlington, N. J., which has developed a new method of diffusing large volumes of

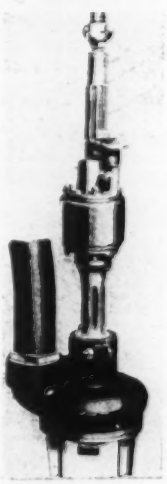


IMPULSE DRY FEED DIFFUSER

gas by means of a device known as the Paradon impulse-type dry feed diffuser. With this device the gas is applied directly to the water or sewage, but instead of depending on bubbling toward the surface for absorption, a stream of water under high velocity is played on the rising bubbles of gas. This stream accomplishes four purposes: first, it causes the gas bubbles to take a horizontal instead of a vertical path, thereby increasing the time of contact; second, the high-velocity stream minutely divides the bubbles, thus increasing the area of contact; third, as the size of the gas bubbles is much less, their buoyancy is decreased, resulting in a slower rate of rise to the surface, which again increases the time of contact; fourth, the high-velocity stream of water produces violent agitation of the water or sewage adjacent to the point of gas application, with resulting greater diffusion. In a typical installation using impulse diffusers, the manufacturer states that 200 lb. of chlorine per 24 hours was applied with a water consumption of only 360 gal. per hour, compared with approximately 10,000 gal. per hour, which would be required for corresponding solution feed units. When desirable, sewage or other liquids can be used to operate the diffuser.

## Portable Pump Driven by Air

Contractors and public utility companies faced with the necessity of removing water from manholes or pits will be particularly interested in the Quimby pneumatic sump pump announced by the Chicago Pneumatic Tool Co., New York City. This is an air-operated unit weighing but 40 lb. with a capacity of 100 gal. per minute at a 28-ft. head. Steady capacities can be obtained with heads up to 50 ft. The centrifugal pumping unit is driven by a rotary air motor, the exhaust from which serves to rid the manhole or pit from dangerous gases or fumes while pumping. Using a 2½-in. water hose for an outlet and a ¼-in. air line, the pump can be easily taken from job to job, as pipe or heavy reinforced hose are not necessary. No priming difficulties are experienced; the motor is started running before submersion and the complete unit is lowered into the manhole or pit.



PNEUMATIC PUMP

## Three-Position Pilot Switch

Motor-driven pumps, compressors and similar machines which are controlled by an automatic pilot device such as a float switch, pressure switch or time clock often require some means of starting and stopping the motor manually. For this purpose Cutler-Hammer, Inc., Milwaukee, Wis., has developed a new three-position pilot switch. The operating lever can be placed in the "automatic," "off" or "manual" position. When turned to "automatic," the automatic pilot device is in circuit, and normal, automatic operation is obtained. With the lever in the "off" position, the pilot circuit is opened, and the motor cannot be started from any other control point. Turning the lever to the "manual" position closes the control circuit direct and the motor will run continuously regardless of any other

control devices as long as there is operating voltage on the line. The construction is extremely simple. It consists of a two-button pushbutton switch inside the case, the buttons of which are operated by a cam attached to the operating lever. The lever will remain in any one of the three positions.

## Joint-Sealing Compound Uses New Mineral

Through the use of a newly discovered micaceous mineral which expands when subjected to heat, the Quigley Co., Inc., 56 West 45th St., New York City, has produced a plastic, expansive compound for sealing thread, flange and gasket joints which is known as Q-Seal. The mineral, which is used as the principal pigment, is ground to a very fine mesh and mixed with a vehicle said to be impervious to crude oil, all of its derivatives, and acids. The compound is non-corrosive. It is applied with a brush, and can be thinned with water to the consistency most desirable for the work in hand.

## *Business Notes*

CHICAGO BRIDGE & IRON WORKS, Chicago, Ill., has opened a new sales office in Tulsa, Okla., in charge of D. A. Leach.

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa., has appointed two assistant district managers: Fred T. Whiting for the Northwestern district, and T. R. Langan for the Northeastern district. Mr. Langan will continue as manager of the transportation division of the Northeastern district.

BROWN INSTRUMENT Co., Philadelphia, Pa., announces the retirement of George W. W. Cornman as treasurer and manager of the service department after 35 years with the instrument business. The department will be in charge of R. C. Kennan as manager, with E. T. Nahill as field supervisor.

INTERNATIONAL NUTYP TOOL CORP., Oswego, N. Y., has assumed control of the Oswego Tool Co. with a complete change in management. New officers include N. W. Stone, president and general manager; E. B. Russell, vice-president and treasurer; and E. W. Fulton, vice-president and works manager. The Oswego line of small tools will be rounded out, and plant expansion is under consideration.

WOOD PRESERVING CORPORATION OF PITTSBURGH, Pa., has been formed, uniting the Ayer & Lord Tie Co., of Chicago, and the Century Wood Preserving Co., of Pittsburgh. The two companies will continue under their present names and managements.

CLIMAX ENGINEERING Co., Clinton, Iowa, announces the following changes: L. L. Machia, in charge of oilfield sales, has changed his headquarters from Clinton, Iowa, to Fort Worth, Tex. Sales in Kansas, Oklahoma and Arkansas have been placed in charge of Forest Dunlap, with headquarters in Tulsa, Okla. F. E. Blanchard, in charge of dealers and service parts organization and the power unit division of the company, has taken up headquarters at the main office in Chicago. Repair parts for all of the company's products in the New York district will be supplied by the Climax Engine Service Co., 115 Broad St., New York City, succeeding the John H. Reiner Co.

A. M. BYERS Co., Pittsburgh, Pa., has closed its hand puddle mill at Girard, Ohio, the largest single unit of hand puddle furnaces in the country. This step was taken in anticipatiton of the opening of a new mill on the Ohio River just outside of Pittsburgh which will have an ultimate capacity of 45,000 tons a month, compared with the Girard plant's output of 5,000 tons a month. At the new works plate for pipe will be rolled directly from the billet, instead of piling and reheating muck bars, as was the former practice. The new mill, which will open in October, affords facilities for producing plate and bar iron as well as pipe.

HERCULES MOTORS CORP., Canton, Ohio, has established a new office in the Chanin Building, New York City, in charge of C. P. Weekes, manager of the Eastern territory.

WALLACE & TIERNAN Co., INC., Newark, N. J., announces the following changes in assignments: F. G. Merckel, for the past eight years manager of the Chicago office, has been appointed sales manager of Wallace & Tiernan Products, Inc., and will move to the head office at Belleville, N. J. C. O. Bruden, formerly assistant manager, will assume the duties of the position vacated by Mr. Merckel. W. A. Hockett, manager of the Indianapolis office, has been transferred to the home office at Newark, N. J., and will have charge of the company's foreign activities. E. F. Kinney has been appointed district manager at Indianapolis to succeed Mr. Hockett. Charles H. Eastwood, formerly in charge of foreign sales, is now in charge of advertising and publicity for Wallace & Tiernan Co. and Wallace & Tiernan Products, Inc.

ST. JOHN X-RAY SERVICE CORP., New York City, has installed an unusual X-ray plant at the Barberton (Ohio) works of the Babcock & Wilcox Co. for the photographic inspection of welded seams in pressure vessels, heat exchangers and similar equipment.

SALT LAKE FOUNDRIES, INC., has been organized to take over the Western Steel & Foundry Co. and operate it in conjunction with United States Foundries, Inc. J. C. Dick, general manager of the Western plant at Midvale, Utah, is vice-president and treasurer of the new company and A. C. Hovey, president of United States Foundries, Inc., of Denver, will be president.

PENNSYLVANIA-DIXIE CEMENT CORP., New York City, has appointed B. W. Druckenmiller assistant general sales manager, with headquarters in New York City. For the past two years he has been sales manager, in which position he will be succeeded by F. J. Selinger, Jr., who until a few months ago was connected with the Atlas Portland Cement Co.

AMERICAN MANGANESE BRONZE Co., Philadelphia, Pa., has received an order for more than 1,000,000 lb. of bronze castings to be used in connection with the new water supply for the city of New York. Individual castings will vary in weight from 4,000 to 28,000 lb. and will be subjected to a hydrostatic test of 250 lb. before shipment.

## *Costs and Contracts*

### E. N.-R. Index Numbers

| Cost | | | Volume | |
|---|---|---|---|---|
| **Sept. 1, 1930** | **199.58** | **August, 1930** | | **259** |
| Aug. 1, 1930 | 200.95 | July, 1930 | | 226 |
| Sept. 1, 1929 | 207.57 | August, 1929 | | 290 |
| Average, 1929 | 207.02 | Average, 1929 | | 317 |
| Average, 1928 | 206.78 | Average, 1928 | | 287 |
| 1913 ..... | 100.00 | 1913 ..... | | 100 |

### This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Sept. 11, with some comparisons, total as follows:

(In Thousands of Dollars)

| | Sept. 11, 1930 | Average Sept. 4, 1930 | Sept. 12, 1929 |
|---|---|---|---|
| Buildings: | | | |
| Industrial ..... | $4,599 | $6,498 | $6,678 |
| Other ..... | 27,859 | 17,621 | 29,863 |
| Streets and roads.. | 10,289 | 8,972 | 12,603 |
| Other eng. constr.. | 10,970 | 17,977 | 12,062 |
| Total ..... | $53,717 | $51,068 | $61,206 |

Total, all classes, Jan. 1 to Sept. 11:

| | |
|---|---|
| 1930 ..... | $2,458,657 |
| 1929 ..... | 3,038,191 |

## *New Publications*

*Pipe Plugs*—WATER WORKS EQUIPMENT Co., 50 Church St., New York City, has issued an 8-p. leaflet describing several kinds of pipe plugs.

*Sewage Treatment*—The Laughlin method of mechanical sewage treatment is outlined in bulletin A, published by the FILTRATION EQUIPMENT CORP., 350 Madison Ave., New York City.

*Water and Sewage Treatment*—Representative sewage and water treatment plants are illustrated and described in a 40-p. booklet issued by the DORR Co., 247 Park Ave., New York City. This is the second publication of its kind, the first having been issued about a year ago.

*Remote Control*—The de Florez system of remote manual control by the application of Selsyn motors, by means of which the operator can retain the actual "feel" of the mechanism being operated, is described in bulletin 7520 of the BROWN INSTRUMENT Co., Philadelphia, Pa.

*Piledrivers*—Practically every kind of piledriving work done at the present time is illustrated in a 112-p. bulletin No. 40 issued by the MCKIERNAN-TERRY CORP., 15 Park Row, New York City. A large proportion of this book is taken up in describing individual jobs in many parts of the world in which the products of the company were used. Engineers and contractors interested in pile construction will find much useful information within its pages.

*Welding*—Manual welding of unbeveled mild steel plates is the subject discussed in an 8-p. engineering bulletin 6 of the FUSION WELDING CORP., Chicago, Ill.

*Earth-Moving Equipment*—Catalog 80 of the WESTERN WHEELED SCRAPER Co., Aurora, Ill., describes in 144 pages a very extensive line of grading tools and machines, giving special prominence to dump cars of both drop-door and lift-door types. The catalog is very complete, containing many excellent illustrations.

*Paint*—Iron and steel plaint protection is the subject considered in "Master Specifications," issued by the JOSEPH DIXON CRUCIBLE Co., Jersey City, N. J. The booklet is designed to simplify the problem of paint selection and to assist the specification writer.

*Tanks*—The spheroidal design of oil storage tanks with a flattended bottom, designed to use metal with maximum economy, is fully described in a 10-p. illustrated booklet issued by the CHICAGO BRIDGE & IRON WORKS, Chicago, Ill.

*Pipe Coating*—"What Research Has Developed for Pipe Coating" is briefly discussed in a leaflet issued by the OHIO VARNISH Co., Cleveland, Ohio.

*Concrete Forms*—Blawforms for general concrete construction are described and illustrated in great variety in an attractive 112-p. illustrated publication of the BLAW-KNOX Co., Pittsburgh, Pa. Separate chapters are devoted to engineering structures of many kinds, including conduits, tunnels, walls, piers, dams, subways, bridges and roads.

*Paving Mixers*—Bulletin 125 of the RANSOME CONCRETE MACHINERY Co., Dunellen, N. J., takes up in detail the many improvements made in the new Master 27-E paver. Special features include a power loader, improved water tank, crawler and chain drive, inclosed gears and calcium chloride attachment.

*Heating Equipment*—Portable oil-burning road and street maintenance equipment is described in bulletin 86 of the AEROIL BURNER Co., INC., West New York, N. J.

*Grading Equipment*—Hydraulic dirt movers, bulldozers, scarifiers and tamping rollers for tractor operation are described in bulletin 302 of the AMERICAN TRACTOR EQUIPMENT Co., Oakland, Calif.

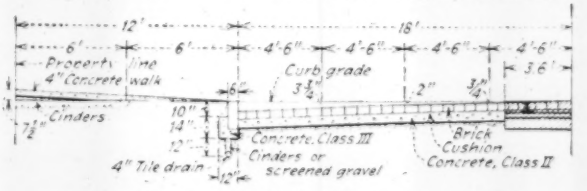
*Guy Anchors*—Bulletin 803 of the W. N. MATTHEWS CORP., St. Louis, Mo., illustrates and describes a number of types of earth anchors for guy wires, including Matthews Scrulix, Xpandix and Traplox anchors.

*Lock-Thread Bolts*—Results of tests upon the effect of length of thread exposure upon the static tensile strength and energy to rupture of standard V and Dardelet thread and nut connection, made at the Columbia University testing laboratories, are given in a 12-p. bulletin issued by the DARDELET THREADLOCK CORP., 120 Broadway, New York City.

# Unit Prices From Current Construction Bids

## Fiber Brick With Asphalt Filler at Akron

HOME Ave., a thoroughfare connecting East Akron, Ohio, and the municipal airport with Cuyahoga Falls, Silver Lake and Kent, is being paved with 3½-in. vertical fiber brick with asphalt filler to a width of 36 ft., as shown in the cross-section. This street is a link in the main high-




HALF SECTION OF BRICK PAVEMENT, AKRON

way known as Arlington St., which was already paved from its beginning at the airport to Upson St., where a section west of four railroad crossings remains unimproved. Following the present paving job a reinforced-concrete trestle will be constructed over these tracks closing the unpaved gap in Arlington St. from Upson St. to Home Ave. This structure is scheduled for erection in two years.

| | A | B | C |
|---|---|---|---|
| 8,700 cu.yd. grading | $0.35 | $0.40 | $0.35 |
| 6,610 lin.ft. under drainage pipe | .02 | .04 | .02 |
| 1,000 inlet connections, 12-in. pipe | 1.00 | .90 | .90 |
| 145 inlet connections, 15-in. pipe | 1.50 | 1.20 | 1.25 |
| 300 cu.yd cl. 2 concrete retain. wall | 8.00 | 10.00 | 11.00 |
| 6,030 lin.ft. sandstone curb 5x18 in. | 1.30 | 1.25 | 1.28 |
| 605 lin.ft. granite circ. curb 6x18 in. cl. A | 2.70 | 2.70 | 2.70 |
| 605 lin.ft. granite circ. curb 6x18 in. cl. B | 2.70 | 2.50 | 2.45 |
| 370 lin.ft. sandstone headers | 1.00 | .90 | .90 |
| 14,115 sq.yd. concrete base | | | |
| 5-in. | .97 | 1.15 | 1.15 |
| 6-in. | 1.14 | 1.30 | 1.30 |
| 7-in. | 1.32 | 1.48 | 1.45 |
| 8-in. | 1.51 | 1.65 | 1.90 |
| 17,190 sq.yd. curing base | .03 | .02 | .02 |
| 13,010 sq.yd. 3½-in. vert. fiber brick, asph. fill | 1.79 | 1.80 | 1.87 |
| 1,550 sq.yd. 3-in. V.F. brick gutter, asph. fill | 1.80 | 1.90 | 1.85 |
| 1,105 sq.yd. hillside brick pav. | 2.10 | 2.10 | 2.15 |
| 37,420 sq.ft. cement walk, 2-course | .20 | .19 | .19½ |
| 4,000 sq.ft. cement driveway | .25 | .23 | .24 |
| 2,000 lb. reinf. steel | .03 | .04 | .04 |
| Totals, with 6-in. base | $76,281 | $79,341 | $80,130 |

Seven bids were received and contract was awarded in May, 1930, on the lowest, $76,281, which was 4 per cent below the second and 6 per cent below the average bid. Principal unit prices are given of the lowest three bidders: A, Columbus Asphalt Paving Co.; B, Hollinger-Davidson Co.; C, Paul S. Maline. E. A. Kemmler is highway engineer of the department of public service.

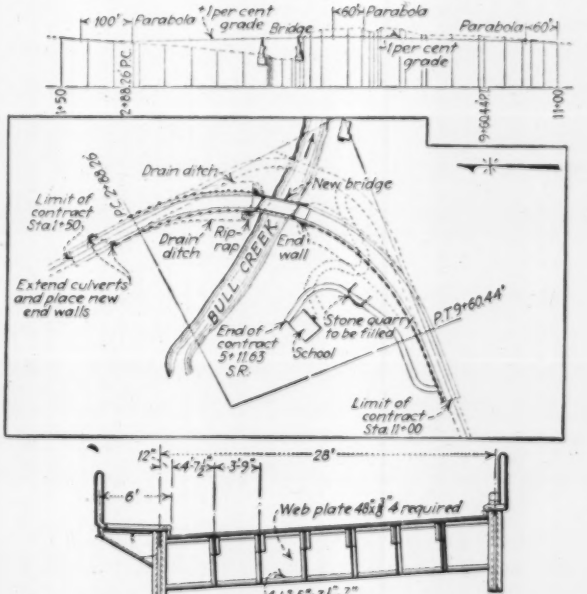
## Bridge in Allegheny County, Pa.

CONTRACT for bridge 3 over Bull Creek in Allegheny County, Pa., let in July, 1930, to the lowest bidder for $41,443, includes building a steel superstructure on concrete abutments and earthfill approaches on a radius of 400 ft. from P. C. 2 + 88.26 to P. T. 9 + 60.44, as shown in the drawing, and removal and disposal of the present bridge. The new bridge, on a 1 per cent grade, is skewed about 30 deg., is 66 ft. long inside of back walls and 34 ft. wide, including a 6-ft. cantilever sidewalk. The north and deeper abutment is 28 ft. high with base 11½x47 ft. set 1 ft. in rock. The south abutment is 24 ft. high with base 11½x40 ft. Both are faced with 9-in broken stone. The backs of the abutments and wingwalls are waterproofed with tar. All construction joints are waterproofed with a strip of two layers of membrane waterproofing, price included in item 7.

Vehicular and pedestrian traffic is to be maintained throughout the contract. When the existing bridge is no longer required the contractor will dismantle it and place all sound materials on cars at Tarentum. Item I includes the expense of removing the concrete masonry and placing all stone for riprap around the new abutments.

| | A | B | C |
|---|---|---|---|
| 600 cu.yd. excav. for fnd., incl. removal of masonry of existing bridge | $3.00 | $1.50 | $3.50 |
| 6,800 cu.yd. excav. (grading) not incl. in item I | .70 | .70 | .70 |
| 325 cu.yd. conc. in fnd. of abuts., wingwalls and end walls | 13.50 | 14.50 | 14.00 |
| 495 cu.yd. conc. above fnd. | 14.50 | 16.50 | 15.00 |
| 14,000 lb. steel reinf. and dowels | .04 | .045 | .05 |
| 60 cu.yd. stone drains | 2.50 | 6.00 | 4.00 |
| 300 sq.yd. tar waterproofing | .35 | .35 | .50 |
| 820 cu.yd. conc. admixtures | .25 | .30 | .40 |
| 100 bbl. extra cement | 2.50 | 3.00 | 2.50 |
| 100 lin.ft. conc. curb and transition curb on approaches | 1.00 | .90 | 1.00 |
| 250 sq.ft. conc. sidewalk on approaches | .30 | .28 | .28 |
| 2,400 sq.yd. one-course reinf.-conc. pavement | 2.85 | 3.10 | 3.00 |
| 36 lin.ft. 12-in. c.i. pipe culvert in place | 3.00 | 4.30 | 3.00 |
| 600 lin.ft. wood post barriers | .85 | .92 | 1.00 |
| 110,000 lb. structural steel and anchor bolts, incl. all painting in place | .0665 | .065 | .055 |
| 5,000 lb. cast steel, incl. all painting in place | .20 | .27 | .26 |
| 2,100 lb. malleable iron railing posts, incl. all painting in place | .16 | .24 | .16 |
| 1,900 sq.ft. roadway floor grating, incl. all painting, in place | 1.65 | 1.10 | 1.75 |
| 1,900 sq.ft. conc. in floor grating | .25 | .27 | .20 |
| 140 lin.ft. conc. in bridge curb | 1.00 | 1.20 | .50 |
| 70 lin.ft. conc. safety curb in place | 1.00 | 1.25 | 2.00 |
| 1 malleable iron scupple in place | 100.00 | 100.00 | 160.00 |
| 600 lin.ft. broken stone and 6-in. T.C. pipe subdrain | .85 | .70 | 3.00 |
| 40 lin.ft. 24-in. conc. pipe culvert | 4.00 | 5.00 | 4.00 |
| Removal and disposal superstructure existing bridge | 300.00 | 150.00 | 800.00 |
| Totals | $41,443 | $42,275 | $42,462 |

Work has started and duration is four months, with a penalty of $25 per day. Bids were received from thirteen contractors, and contract was awarded to (A) Union Engineering & Contracting Co., Investment Bldg., Pittsburgh, whose bid was 2 per cent under the second and 14 per cent below the average. Unit prices are given of the low and the next two bidders: (B) Frank S. Tillman & Co.; (C) Alow-Hanson Engineering & Construction Co.




PROFILE, PLAN, AND CROSS-SECTION OF BULL CREEK BRIDGE, PA

# Unit Prices From Current Construction Bids

## Steel Highway Bridge and Approaches, Arkansas

A STEEL highway toll bridge and approaches over the White River at Clarendon, Ark., on the relocation of highway 3 in Monroe County is being constructed by the Austin Bridge Co., Dallas, Tex., under a contract awarded in June, 1930, for $1,532,572. Work includes a concrete approach on the east side of the river, and a steel and concrete approach and earthfills between the river and Rock Roe Bayou on the west side (Fig. 1). The entire structure has reinforced-concrete roadway between curbs of 24 ft.

The main structure is a high cantilever bridge with a central span of 400 ft. and two 160-ft anchor arms. The cantilever structure is supported on two main piers sunk by the pneumatic process, and two anchor piers sunk by cofferdams and carried on timber piles.

The east approach consists of twelve 47-ft. and twelve 40-ft. concrete-girder spans and 280 ft. of earthfill inclosed by retaining walls. Foundations rest directly on soil 6 ft. below the surface without piling, except bents 18 to 23, which are on concrete piles.

Six sections comprise the west approach: (a) one steel-girder span 69 ft. and 36 of 68 ft., total 2,517 ft.; (b) 1,963 lin. ft. earth embankment; (c) 55 steel girder spans of 68 ft.; (d) 8,377 ft. earth embankment; (e) 21 steel girder spans of 68 ft.; (f) five reinforced-concrete retaining walls. The girder spans are supported on concrete columns and caps. Reinforced-concrete piles are driven under all foundations, except in the two crossings of Old River, where timber piles are used.

Concrete is of three classes as follows:

| | Aggregate to Cement | Bags Cement per Cubic Yard | Mix | Pounds Test 7-Day | Pounds Test 28-Day |
|---|---|---|---|---|---|
| A | 6 | 6 | 1:2:4 | 1,300 | 2,000 |
| B | 7.5 | 5 | 1:2½:5 | 1,000 | 1,500 |
| E | 3 | 10 | 1:1:2 | 2,000 | 3,000 |
| F | 3 | 10 | 1:1:2 | 2,000 | 3,000 |

The difference between classes E and F is in the aggregate requirements. These for A are: retained on 1½-in. sieve, 0 to 5 per cent; ¾-in., 25-60 per cent; ⅜-in., 50-75 per cent; on No. 4, 95-100; and for B: retained on ⅜-in. 50-75 per cent; on No. 4, 95-100 per cent. Class A is used for sealing working chambers and shafts of the pneumatic caissons, for shafts and webs of main piers, for bases and caps of columns and for the end retaining walls. Class B is for bases of pneumatic piers, from tops of roofs of working chambers to tops of braces or bottom of pier shafts. Class E is for approach spans above tops of column pedestals, except hand rails and lamp posts, and for the floor slab and curbs on the steel spans. Class F is for hand rails and lamp posts.

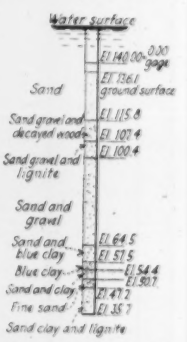



FIG. 2—LOG OF WASH BORINGS DOWNSTREAM FROM RIVER PIER 3

The girders and columns of the east approach are built in bays divided by expansion joints. The columns are run up to the bottoms of the longitudinal girders, and after setting seven days the longitudinal girders, transverse struts and floor slabs from expansion joint to expansion joint are run simultaneously in one pour.

Unit prices are given of the general contractor, and the second and third bidders, all of Dallas: A, Austin Bridge; B, L. H. Lacey Co.; C, Fuller Construction Co. The American Bridge Co. is fabricating the steel I-beams, 4,000 tons, for the west approach, and the Virginia Bridge Co. is fabricating the steel for the main cantilever bridge. The Union Bridge & Construction Co. is sinking the four main piers for the cantilever span; Williams & Williams are building the Rock Roe section of the west approach, and the earthwork is being done by Gifford & Hill, Dallas. Ira G. Hedrick, Inc., Hot Springs National Park, is consulting engineer.

| | A | B | C |
|---|---|---|---|
| 156 acres clearing | $70.00 | $70.00 | $75.00 |
| 75 acres grubbing | 120.00 | 120.00 | 125.00 |
| 5,620 cu.yd. excav. for retaining walls and column bases except for bents 35 to 39, 76 to 80, and 123 to 125 | 3.00 | .54 | 1.00 |
| 2,845 cu.yd. class A and B conc. in bases of pneumatic piers 2 and 3, incl. excav. | 30.50 | 40.30 | 47.75 |
| 747 cu.yd. class A conc. in bases of piers 1 and 4, incl. excav. and cofferdams | 21.50 | 34.70 | 36.00 |
| 1,942 cu.yd. class A conc. in bases of columns for bents 35 to 39, 76 to 80, and 123 to 125, incl. cofferdams and excav. | 35.00 | 22.72 | 23.50 |
| 3,750 cu.yd. class A and E conc. in shafts, webs, and copings of piers 1, 2, 3 and 4 | 18.90 | 22.60 | 23.35 |
| 5,100 cu.yd. class A conc. in retaining walls, except hand rails and lamp posts, and for all column bases and caps except for bents 35 to 39, 76 to 80, and 123 to 125 | 21.00 | 22.08 | 21.25 |
| 13,150 cu.yd. class E and F conc. in approaches above column bases and caps, incl. hand rails and lamp posts, also floor-slabs and curbs on main bridge | 21.50 | 24.93 | 26.25 |
| 39,960 lin.ft. precast reinf.-conc. piles, class F, in place | 2.45 | 2.50 | 2.55 |
| 25,080 lin.ft. 60-ft. timber piles in place | 1.10 | .75 | .78 |
| 2,200,000 lb. structural steel in main river bridge, erected, riveted and painted, incl. anchorages and cast-steel shoes | .068 | .0728 | .07 |
| 7,747,000 lb. structural steel in west approaches, incl. bearing plates, castings, and anchor bolts, erected and painted | .0385 | .0337 | .035 |
| 3,130,000 lb. reinf. steel, except for conc. piles | .038 | .0433 | .045 |
| Electric light wiring and fixtures for 58 lights | 7,200.00 | 8,000.00 | 3,000.00 |
| 200 lb. bronze expansion plates and bolts | .50 | .50 | .40 |
| 740,000 cu.yd. earthfill | .21 | .22 | .22 |
| 4 bronze nameplates, 20x30-in., in place | 75.00 | | |
| Toll taker's residence and office, complete | 9,000.00 | 8,400.00 | 8,000.00 |
| Total | $1,532,572 | $1,588,204 | $1,637,933 |

## Asphalt or Concrete Paving, Sutter Co., Calif.

ALTRENATE bids were received July 1, 1930, for surfacing with concrete or asphalt, on 5-in. crusher-run base, secs. 6 to 9 of the Woodland-Yuba City cutoff in Sutter Co., Calif. Contract was awarded to J. E. Johnston, Stockton, for type A asphalt at $7.60 per cubic yard; his bid on concrete was $9. The lowest bid on reinforced-concrete was $8.47 per cubic yard.

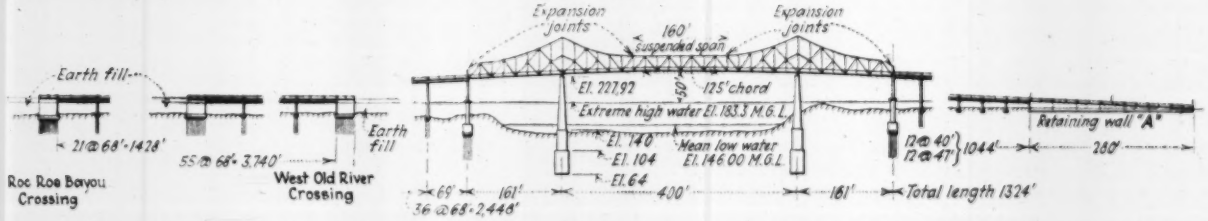



FIG. 1—PROFILE OF WHITE RIVER BRIDGE AND APPROACHES, CLARENDON, ARK.

# CONSTRUCTION NEWS

## Some of the Week's Large Projects

For further details turn to the appropriate sections in this issue

| Location | Project | Cost | Status |
|---|---|---|---|
| **Waterworks** | | | |
| Quebec | Reservoir | $1,000,000 | Proposed |
| **Bridge** | | | |
| Connellsville (Pa.) | Bridge and grading | 1,700,000 | Contract |
| **Streets and Roads** | | | |
| Chicago | Paving | 1,400,000 | Contract |
| New Jersey | Paving | 1,547,418 | Contract |
| **Excav. and Dredging** | | | |
| Windsor (Ont.) | Drainage | 2,000,000 | Proposed |
| **Railways** | | | |
| Texas | Railway Ext. | 3,000,000 | Proposed |
| Ontario | Railway | 2,000,000 | Contract |
| **Factories and Mills** | | | |
| San Francisco | Cold storage plant | 1,000,000 | Proposed |
| Fitchburg (Mass.) | Factory | 1,000,000 | Proposed |
| New York | Factory | 4,000,000 | Separate contracts |
| Clairton (Pa.) | Coal washing plant | 2,000,000 | Contract |
| Copper Cliff (Ont.) | Refinery | 2,000,000 | Contract |
| Sault St. Marie (Ont.) | Steel mill | 1,250,000 | Proposed |
| **Warehouses** | | | |
| New York | Warehouse and garage | 1,500,000 | Proposed |
| **Buildings** | | | |
| Brooklyn | Apartment | 1,400,000 | Bids asked |
| New York | Apartment | 1,000,000 | Bids asked |
| Seattle (Wash.) | Hotel | 1,500,000 | Bids asked |
| Saskatoon (Sask.) | Hotel | 2,000,000 | Bids asked |
| New York | Y. M. C. A. | 1,000,000 | Bids asked |
| Riverside (Calif.) | Sanitarium | 1,000,000 | Proposed |
| Malden (Mass.) | Hospital | 1,000,000 | Contract |
| New York | Office | 2,000,000 | Proposed |
| New York | Office | 10,000,000 | Proposed |
| Oklahoma City | Office | 3,000,000 | Contract |
| Toronto | Office | 1,000,000 | Proposed |
| San Francisco | Memorial | 2,500,000 | Proposed |
| Chicago | University | 3,000,000 | Bids asked |
| San Francisco | Theatre | 2,500,000 | Proposed |
| Albany (N. Y.) | Theatre | 3,000,000 | Proposed |
| Buffalo | Terminal warehouse | 1,000,000 | Contract |
| New York | Garage | 1,000,000 | Proposed |
| Montreal | Telephone exchange | 1,000,000 | Contract |

## WATERWORKS

### PROPOSED WORK

**Calif., Menlo Park**—Bear Gulch Water Co., surveys 35,000 lin.ft. 24 in. riveted or welded steel with soiled proof wrapping, or rein.-con. pipe line, 11,200 g.p.m. pumping plant, 880 acre ft. storage reservoir. $325,000. H. B. Foster, University of California, Berkeley, engr.

**Mass., Waltham**—Soon takes bids on revised plans high pressure water plant, incl. tank, pump house, standpipe, piping. $50,000. City Engineer, City Hall, engr.

**Mass., Worcester**—Preliminary surveys dam, pipe line, pumping station, Quinapoxet Pond to Kendall Reservoir, incl. 20,000 lin.ft. 36 in. pipe, 3 pumps, 21 m.g.p.d., transmission line, equipment, etc. $400,000. R. G. Lingley, city engr.

**Mont., Great Falls** — City filter plant and pumping station, $250,000; soon takes bids 4 m.g. reservoir, $90,000. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., engrs.

**Neb., Omaha**—Metropolitan Utilities Dist., T. Liesen, 18th and Harney Sts., pumping station equipment, Bedford and Fontenelle Aves. $150,000. C. D. Robinson, c/o owner, engr. Architect not selected.

**O., Cleveland Heights**—City plans 1 m.g. water storage tank. $25,000. F. A. Pease Eng. Co., Terminal Tower, Cleveland, engrs.

**Okla., Anadarko**—Preliminary plans deep well water supply. $20,000. H. N. Kunkel, Anadarko, engr.

**Okla., Chandler**—Preliminary plans additional drilled well water supply. $17,000. L. C. Green, Chandler, engr.

**Okla., Cherokee**—Preliminary plans new well water supply. $20,000. C. H. Guernsey, Cherokee, engr.

**Okla., Ryan**—Preliminary plans new drilled well water supply. $17,000. C. M. Dean, mayor.

**Tenn., Lebanon**—Preliminary plans water extension, complete filter plant, pipe lines to river. $200,000. Weideman & Singleton, Atlanta, Ga., engrs.

**Ont., Hamilton**—City Council 10,000,000 imperial gal. reservoir, Mountain Ave. $400,000. W. McFaul, City Hall, engr.

**Que., Quebec**—City Council, F. X. Chouinard, clk., 30 m.g. underground reservoir. $1,000,000. E. Hamel, city engr. J. A. Tremblay, waterworks engr. Noted Mar. 27.

**Que., Valleyfield** — City, 1,000 g.p.m. centrifugal pump for waterworks. R. Belanger, city engr.

### BIDS ASKED

**La., Morgan City**—Sept. 15, by City Council, electric transmission system, incl. 5,700 ft. 10 in. Class B iron pipe, 1,500 ft. 6 in. Class B c.i. pipe, hydrants, valves, boxes; also two 1,000 g.p.m. underwriters motor driven pumps. Swanson & McGraw, Balter Bldg., New Orleans, engrs.

**La., Monroe**—Sept. 16, by City Comm., two 350 g.p.m. domestic service motor driven pumps, one 1,000 g.p.m. and one 3,000 g.p.m. low head motor driven pumps, 12,000 gal. oil storage tank. Swanson & McGraw, Balter Bldg., New Orleans, engrs.

**Md., Baltimore**—Sept. 25, by Bd. Awards, at office City Register, City Hall, constructing Prettyboy Dam. E. G. Rost, waterworks engr.; adv. E. N.-R. Sept. 11. Noted Sept. 4.

**Mich., Detroit**—Sept. 16, by Dpt. Water Supply, concrete foundation for 2 m.g. steel water tank, tower, Trojan Ave. $30,000. G. H. Fenkell, 735 Randolph St., engr.

**Neb., Carleton**—Sept. 18, by H. B. Wittenberger, village clk., water works, incl. 50,000 gal. tank on 70 ft. tower, c.i. pipe, galvanized hydrants, tubular well, pumps, motor, pump house. $22,897. Henningson Eng. Co., 326-30 Union State Bank Bldg., Omaha, engrs.

**N. J., Trenton**—Sept. 19, by City Comm., two 20 m.g.p.d. De Laval centrifugal pumps, driven by 675 hp., 900 r.p.m. synchronized motors, one 220 kw., 1,200 r.p.m. rotary converter 4,150 volt, 3 phase, 60 cycle; one a.c. current switchboard, necessary wiring from Pub. Serv. system; one 25 kva. 4,150 to 110 and 220 volt single phase transformer, etc., at Calhoun Street Pumping Station. A. Bugbee, city engr. Noted May 22.

**N. Y., New York**—Sept. 16, by Bd. Water Supply, Gas & Electricity, Municipal Bldg., mains in Throgg's Neck Blvd., Country Club Rd., Agar Pl., Allerton, Hobart, Nereid, Pilgrim, Radcliff, Throop, Tibbett and Wilder Aves., Benson, Odell and West 232nd Sts.

**Tex., Pettus**—See "Contracts Awarded."

### CONTRACTS AWARDED

**Calif., Los Angeles**—City 15,000 ft. ¾ in. red brass pipe, to Chase Brass & Copper Co., 210 South Central Ave., at $19 per 100 ft.; 20,000 ft. ¾ in. copper service tubing, to Crane Co., 231 3rd St., at $14.50 per 100 ft.

**Calif., Los Angeles**—T. Oughton, city purch. agt., core drilling on Route B- Mono Basin for Water & Power Dpt., Spec. 2148, to Continental Diamond Drilling Co., Pacific Natl. Bank Bldg., $12,690, with $4,030 additional for drilling over 3,000 ft.

**Calif., San Francisco**—City Park Comm., furnishing, installing deep well turbine and motor at Murphy Windmill in Golden Gate Park, to Kimball-Krogh Pump Co., 147 Beale St., $2,674. 2 deep well turbines, motors at Sharp Park, to Industrial & Municipal Supply Co., 7 Front St., $2,336.

**Calif., San Diego**—See "Streets and Roads."

**Ind., East Chicago**—Bd. Trustees Dpt. Waterworks, 4735 Olcott Ave., waterworks intake improvements, pipe, to Petroleum Iron Wks., Sharon, Pa.; well and laying pipe, to Merritt, Chapman & Scott, 17 Battery Pl., New York. Noted Aug. 7.

**La., Kenner** — Bd. Comrs. East Jefferson Waterworks Dist. 1, c.i. pipe, to Wilson Hewitt Co., Asheville, N. C., $306,769; valves, hydrants, to R. D. Wood & Co., 400 Chestnut St., Phila., Pa., $46,209. Noted Aug. 7.

**Md., Baltimore**—Bd. Awards, mains in Pennington Ave., to M. & J. B. McHugh, 3716 Sequoia Ave., $28,859. Former contract rescinded. Noted Sept. 4 under "Contracts Awarded."

**Mass., Boston**—Laying, relaying c.i. water pipe in Washington Pl., etc., Roxbury, to Appel & O'Toole, 78 Moreland St., Roxbury. Est. $15,000.

**Mass., Onset**—Town of Wareham, C. I. Hammond, Onset, standpipe for waterworks, to Petroleum Iron Wks., Sharon, Pa., $2,265; foundation, to W. H. Barker, 4 Cohannet St., Taunton, $5,302.

**Mass., Reading**—Town, Bd. Selectmen, stand pipe for waterworks, to Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Est. $15,000 or more.

**Mich., Detroit**—Dpt. Water Supply, furnishing, erecting 2 m.g. steel water storage tank, Greenfield Rd. and Northwestern Hy., to Chicago Bridge & Iron Wks. Co., 37 West Van Buren St., Chicago, Ill., $119,850.

**Minn., Minneapolis**—F. S. Gram, city purch. agt., 6,840 lin.ft. 24 in. and 2,480 lin.ft. 8 in. c.i. pipe, to Amer. C. I. Pipe Co., 712 Plymouth Bldg., at $5.495 and $1.013 per ft. respectively —three 48 in. gate valves, to J. B. Clow & Son, 640 McKnight Bldg., $2,021 each. Noted Aug. 12 Daily.

**Minn., St. Louis Park**—Village, 18,389 lin.ft. 6- to 12-in. c.i. mains, 21 hydrants, 14 gate valves, to Phelps-Drake Co., 711 Metropolitan Life Bldg., Minneapolis, $24,735; 1,000 ⅝ in. and 100 ¾ in. water meters, to Badger Meter Co., 30th and Meinecke Aves., Milwaukee, Wis. Noted Aug. 7.

**N. J., Hillsdale**—Dpt. Institutions & Agencies, State Office Bldg., Trenton, installing service and distribution piping and water lines at New Jersey State Hospital, to Hoffman Wolfe Co., 11 West Rittenhouse St., Phila., Pa., $50,170. Noted July 17.

**N. Y., Brooklyn**—J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in Avenue H, to Draganetti Contg. Co., 711 East 228th St., New York, $6,780. Noted Aug. 21.

**N. Y., Long Island City**—J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in 31st Ave., 33rd St., to S. Galluccl, 33 Railroad Ave., Corona, $8,487. Noted Aug. 28.

**N. Y., New York**—J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., mains in Appleton Ave., to Knidem Constr. Co., $17,740. Noted Sept. 4.

**Pa., Phila.**—Dpt. P. Wks., Bureau of Water A. Murdock, dir., City Hall Annex, to W. R. Curtis, State and Unruh Rds., Contr. 983, $2,100; to M. Brogan & Co., 5322 Locust St., Contr. 991, $6,300; to Structural Steel Eng.

*See proposal advertising on page 150*

*Constr. News page 103*

# LEADITE

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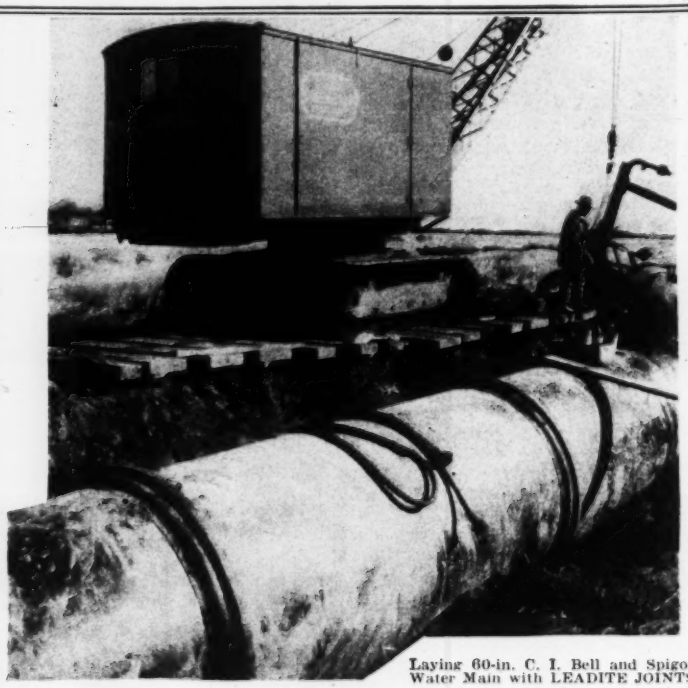

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In Large Cities,—in Small Towns,—in Water Systems of Industrial Plants, Railroads and Mines,—Leadite has been successfully used for jointing Bell and Spigot Water Mains from 4-in. to 84-in. diameter (inclusive),—and for various pressures. In fact, many thousands of miles of water mains in the United States and its Possessions; Latin America, and numerous Overseas Countries, have been satisfactorily jointed with LEADITE.

If you are not already using LEADITE, we sincerely feel that it would be worth your while to investigate it,—and try it on your next pipe laying job.

*The Pioneer self-caulking material for c. i. pipe.*
*Tested and used for over 30 years.*
*Saves at least 75%*

THE LEADITE COMPANY
**Land Title Building** **Philadelphia, Pa.**

**No Caulking**

**Waterworks (Continued)**

Co., 1512 North 13th St., Contr. 992, $5,220; to J. B. McHugh, 892 North Markoe St., Contr. 993, $11,428, Contr. 994, $3,000, Contr. 995, $46,675; to Trotter Co., 36 North Front St., Contr. 996, $695; to Acme Machine Co., 27 North 30th St., Contr. 997, $7,850; to General Electric Co., 1405 Locust St., Contr. 998, $29,294; to Warren Steam Pump Co., Warren, Mass., Contr. 999, $7,051. Grand total $119,613. Noted Aug. 7.

**Tex., Pettus**—Central Power & Light Co., c/o Natl. Bank of Commerce Bldg., San Antonio, extending waterworks, incl. 50,000 gal. steel stand pipe, water distributing system, incl. extensions to oil field inside and outside city limits, fire hydrants, deep well driven by 350 g.p.m. pumping unit, day labor, $30,000. Private plans. Noted Sept. 4.

## SEWERS

### PROPOSED WORK

**Ariz., Tucson**—City, storm and flood water protection, incl. 1,000 c.i. pipe furnished, laid, concrete covering arroyo twin 9 x 12 ft. culvert, at Bway. Subway. $100,000. G. T. Gore, city engr.

**Ark., Forest City**—Preliminary plans sanitary sewer extensions in northern and western sections city. $27,000. Ford & MacCrea, Gazette Bldg., Little Rock, engrs.

**Calif., Capistrano**—Capistrano Beach Sanitary Dist. sewerage system, outfall sewers. $40,000. Burns-McDonnell-Smith Eng. Co., Western Pacific Bldg., Los Angeles, engrs.

**Ill., Centralia** — Soon takes bids sewage treatment plant. $188,000. Pearce Greeley & Hansen, 6 North Michigan Ave., Chicago, engrs.

**N. J., Hammonton**—Bd. Town Council, Town Hall, revised preliminary plans 24 in. relief storm water drain in Pratt St. and 42 in. main in Tilton St. J. A. Baker, Hammontown, engr. Noted July 3.

**Okla., Kingfisher**—Sewage disposal plant, $30,000. Milliken-Whiteneck Eng. Co., Southwest Natl. Bank Bldg., Oklahoma City, engrs.

**Tex., Pettus**—Central Power & Light Co., c/o Natl. Bank of Commerce Bldg., San Antonio, surveys waterworks, incl. well, pumping unit, c.i. pipe distributing system, fire hydrants. $30,000. Private plans.

**Ont., Hamilton**—City Council storm sewers in west end, $500,000; extending sewers in West Hamilton, $200,000. W. McFaul, City Hall, engr.

**Ont., Sudbury**—City Council soon takes bids 2 story, basement, 42 x 80 ft. sewage disposal plant, incinerator, 7,000 ft. 48 in. sewer. W. McMullen, city engr. Noted Sept. 4.

### BIDS ASKED

**Calif., Oakland**—See "Streets and Roads."

**Ky., Louisville**—Oct. 7, by Commissioners of Sewerage, M. E. Taylor Bldg., 4th and Jefferson Sts., Beals Branch Trunk Sewer, Sect. A. Contr. 49. W. M. Cayce, technical engr.; adv. E. N.-R. Sept. 11.

**Md., Baltimore** — Sept. 17, by Bd. Awards, storm sewers, straightening channels Jones Falls, Storm Water Contr. 153; sanitary and storm sewers, Storm Water Contr. 155. M. J. Ruark, Municipal Bldg., sewerage engr.

**N. Y., Elmsford**—Sept. 15, by Bd. Village Trustees, sanitary sewers. Denehy & Clarke, White Plains, engrs. Noted Aug. 14.

**N. Y., Great Neck**—Sept. 22, by Comrs. Belgrave Sewer Dist., Thomaston Apt. Bldg., 9 3rd St., screening chamber and disinfection station, timber trestle, trunk line sewer. C. H. Watson, superv. engr.

**N. Y., New York**—Sept. 16, by H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., sewers in Paine St., Laconia, Bussing, Murdock and Monticello Aves.

**O., Akron**—Sept. 16, by F. E. Swineford, dir. P. Serv., 22,575 ft. 8- to 12-in. sanitary sewers, house laterals in East Market St. and Englewood Ave. Dist. $100,000. A. B. Backherms, Municipal Bldg., engr.

**O., Warren**—Bd. Control bids about Nov. 29, storm water sewerage system in territory between Market, Woodland and Genesee Sts., $250,000; between Washington and Elm Sts., $150,000; Hoyt Run Sewer, $350,000; extending Red Run Sewer from Dana diagonally across to Idylwild Ave., $100,000. W. S. Harvey, Warren, engr.

**Pa., Cannonsburg**—Sept. 15, by W. C. Black, boro secy., 190 ft. 8 in. c.i. pipe, 7,100 lin.ft. 8 in. sanitary sewer pipe, 400 lin.ft. 4 in. sanitary pipe, 32 manholes, accessories in Highfield Ave., Dawson St., Central Alley and outfall sewer connecting with Craighead Street Sewer and Crosby Run Sanitary Sewer.

**Pa., Phila.**—Sept. 17, by Dpt. P. Wks., Bureau Eng. & Surveys, A. Murdock, dir., City Hall Annex, Schedule A, upper Frankford Creek Low Level Collecting Sewer; Schedule B, sluice in bank of Darby Creek at county line.

**Tex., Houston**—Sept. 17, by City, c/o W. E. Monteith, mayor, 3 screens, 1 disintegrator, f.o.b. Houston, for sewage disposal plant. J. M. Nagle, Houston, engr.

### CONTRACTS AWARDED

**Ala., Birmingham** — City Comn., sanitary sewers in 21 blocks 18th and 32nd Sts., 1st to 8th Aves., to J. J. Goddard & Son, Crawford Bldg., $52,904. Est. $93,000.

**Calif., Los Angeles**—Sanitary sewers, resurfacing 109th St. and McKinley Ave., Sewer Dist., to M. Chutuk, 1516 Michigan Ave., $57,420.

**Calif., San Diego**—See "Streets and Roads."

**Ia., Carroll**—W. A. Arts, city clk., sewerage treatment plant; installation mechanical equipment, to F. E. Gray, Carroll, $26,670; mechanical equipment, to Dorr Co., Carroll, $8,390; sludge pump, to Hardinge Co., York, Pa., $718. Grand total $35,778. Noted Aug. 14.

**Mich., Detroit**—Dpt. P. Wks., brick, concrete sewers, manholes in Connors Creek to S. A. Healey, 6501 East Seven Mile Rd., $47,140; Five Points Ave., to J. A. Mercier Co., 450 West Fort St., $32,646; superstructure, Fox Creek Backwater Gates, Jefferson and Ashland Aves., to John L. Beecher Co., 8430 Grand River Ave., $18,645. Grand total $198,431. Noted Aug. 14.

**Mo., St. Louis**—Bd. P. Serv., E. R. Kinsey, pres., City Hall, excavating, rip-rap, 1,900 ft. River Des Peres Drainage Dist. north of Gravois Ave., to W. E. Callihan Constr. Co., Arcade Bldg., $112,850. Est. $143,000.

**Pa., McKees Rocks**—J. W. McLaughlin, secy., Municipal Bldg., 1,252 lin.ft. 36, 42, and 48 in. straight and curved concrete, 814 lin.ft. 30 in. straight and curved concrete or terra cotta sewers in Nichol Hollow, Hanover Sts., to Paris Bros., 4414 Liberty Ave., Pittsburgh, 12,660; 1,028 lin.ft. each 8 and 10 in. terra cotta sewers in McCoy Ave. and 1,265 lin.ft. 10 in. terra cotta sewer in Elizabeth St. to C. T. Martino, 15 McKnight St., Pittsburgh, $20,000, for Bd. Comrs. Stowe Twp. Noted Aug. 7.

**Pa., Phila.**—Dpt. P. Wks., Bureau of Eng. & Surveys, A. Murdock, dir., City Hall Annex, branch sewers in Crittenden St., to Corrado & Froselone, 6045 Magnolia St., $4,781; Durham St., to R. DiVito, 6314 Dicks St., $5,052; Herman and Thompson Sts., to J. J. McHugh, 1617 Race St., $5,279 and $2,392 respectively; Hicks St. and Oxford Ave., to J. T. McDonnell & Co., 2313 South Front St., $4,462 and $7,728 respectively; Large St., to V. Neamand, 625 Levick St., $901; Olney Ave. and 17th St., to E. Ventresco, 6016 Ross St., $5,930 and $843 respectively; Olney Ave. between Ogontz and 20th Sts., to Leva Bros., 104 West Gate St., $15,478; Belgrade and Almond Sts., to D. Sabatini & Son, 2088 McKean St., $24,993; Vernon Rd., to A. Frunzi, 513 High St., $8,466; Wayne Ave., to A. DiSandro & Son, 6100 North 5th St., $4,650. Grand total $90,955.

**S. C., Spartanburg**—Spartanburg & Metropolitan Sewer Dist., T. H. Daniel, chn., constructing Fair Forest Creek and Lawson's Fork intercepting lines, to Fiske-Carter Co., Spartanburg, $123,025 and $133,294 respectively; disposal plant at Fair Forest Creek and Lawson's Fork, to McClelland Co., Charlotte, N. C., $276,012 and $56,827. Grand total $589,158. Noted July 31.

**Tex., Port Arthur**—City, c/o J. W. O'Neal, storm sewer in Stillwell Blvd., to Burns Constr. Co., Dallas, $117,197.

**Wash., Port Angeles**—City Comn., concrete sewerage system East End, to L. Coluccio, 1642 Lane St., Seattle, $70,667. Est. $90,000. Noted Aug. 14.

**Wyo., Green River**—Storm sewer in business section, to J. S. Schwartz Constr. Co., Denver, Colo., $34,320. Noted July 23. Daily.

## WASTE DISPOSAL

### PROPOSED WORK

**Ont., Sudbury**—See "Sewers."

## BRIDGES

### PROPOSED WORK

**Calif., Oakland** — Alameda Co. preliminary plans replacing Park Street Bridge. $25,000. G. A. Posey, Oakland, co. surv.

**Calif., Santa Rosa**—Russian River Crossing Joint Hy. Dist., steel, concrete bridge over Russian River at Jenner-by-the-Sea, Sonoma Co. appropriates $85,000. San Francisco Co. $15,000, Marin Co. $12,500, Mendocino Co. $12,500, state $65,000 toward cost. J. B. Piatt, Santa Rosa, engr.

**Fla., Pensacola** — Comrs. Escambia Co. approved plans for Lillian Bridge. $200,000. W. E. Wheat, co. engr.

**Ore., Arlington**—State, Gilliam Co. (Condon) and City, bridge over Columbia River, $450,000. J. F. Hoss, Yeon Bldg., Portland, engr.

**Pa., Kittanning** — Armstrong Co. 2 piers in river, present abutments on western end of bridge made into pier to carry land span shoreward, new approach from Applewold Ave. on ramp plan, 408 span bowed to give 50 ft. clearance at highest part of bridge for river traffic, 122 ft. and two 238 ft. spans, Market St., $800,000.

**Tex., Stratford**—City, c/o W. T. Martin, mayor, bids after Sept. 15, alternate types paving 10 blocks, 30 ft. $50,000. Devlin Eng. Co., 713 Fisk Medical & Professional Bldg., Amarillo, engrs.

**Que., Gaspe**—Gaspe Bridge Co., Ltd., soon takes bids bridge, $500,000. Engineering and Architectural Staff, Provincial Dpt. Pub. Wks., L. Vallee, deputy minister and ch. engr., Govt. Bldgs., Quebec, engrs. and archts.

**Que., St. Rose**—Provincial Govt., 1,600 ft. steel bridge, 36 ft. over Jesus River, $500,000.

### BIDS ASKED

**Iowa**—See "Streets and Roads."

**Ia., Clarinda** — Sept. 16, at office Auditor Page Co., 122 ft. 6 in. x 16 ft. high truss bridge.

**Kentucky**—State Hy. Dpt., Frankfort, concrete, steel bridge on U. S. Hy. 60 Federal Aid Project 172-AB, Franklin Co., to G. M. Eady, Gilbert and Lee Sts., Louisville, $27,809.

**Maine**—Sept. 18, by State Hy. Dpt., Augusta, Kennebec Bridge, Dresden.

**Maryland**—Sept. 16, by State Roads Comn., Baltimore, concrete paving 1 mi. Contr. S-45-14, Somerset Co. G. C. Uhl, chn. comn.; adv. E. N.-R. Sept. 11.

**Massachusetts**—Sept. 16, by Dpt. P. Wks., Commonwealth of Massachusetts, 1 Ashburton Pl., Boston, 1,480 ft. rein.-con. bridge, and bituminous macadam approaches, Waltham and Weston. A. W. Dean, Dpt. P. Wks., Boston, engr.

**Mass., Weston**—See "Contracts Awarded."

**Michigan**—Sept. 12, at office C. L. Cowgill, resident engr., Plymouth, 60 ft. span steel deck girder bridge, 2 rein.-con. abutments, 22 ft., AB 1 of 58-10-12 Contrs. 1 and 2, Monroe Co., for State Hy. Comn., Lansing.

**Michigan**—Sept. 17, by Washtenaw Co. Rd. Comn., Ann Arbor, RB 1 of 81-4-20 Contrs. 1 and 2, two 55 ft. steel deck girder spans, 30 ft. C. L. Cowgill, Plymouth, resident engr.

**Minnesota**—Sept. 23, by State Hy. Dpt., St. Paul, concrete bridge on S.P. 5-28, at Mankato—bridge S.P. 70-21, south of Fairfax—overhead structure S.P. 2040-1, McGrath — S.P. 2-40-1, Cromwell—on S.P. 20-36, Rochester, Engineering Dpt. Owner, 1246 University Ave., St. Paul, engrs.

**N. Y., Holland**—Sept. 16, by W. G. Hickman, 29 County Hall, Buffalo, 30 ft. span, I-beam bridge, 24 ft. roadway, over Hunters Creek, Sanders Rd., Erie Co.

**O., Cincinnati**—Sept. 26, by Comrs. Hamilton Co., Court House, 4 span, 180 ft. steel, timber bridge on North Bend Rd. $53,798. E. A. Gast, Court House, co. engr.

**Pa., Pittsburgh**—Sept. 16, by R. G. Woodside, controller Allegheny Co., reconstructing floor system, removing, disposing present wood floor and replacing with creosoted oak ties with steel traffic plates bridge over Allegheny River at 62nd St. $53,800. T. S. Covell, 519 Smithland St., engr.

**Texas**—Sept. 15, by G. Gilchrist, state hy. engr., 2 timber trestle bridges, Hy. 57, State Project 790-C, Aransas Co. $56,000.

**Texas**—Sept. 15, by G. Gilchrist, state hy. engr., Austin, rein.-con. bridges on Hy. 70, Fisher and Nolan Counties. $70,000.

**Texas**—Sept. 16, by G. Gilchrist, state hy. engr., Austin, steel, rein.-con. bridges, Hy. 128, Refugio Co. $74,000.

**Texas**—Sept. 16, by G. Gilchrist, state hy. engr., Austin, steel, concrete bridges, Harris Co., $200,000—Motley Co., $56,000—Tarrant Co., $36,000.

**Texas and Oklahoma**—Sept. 16, by G. Gilchrist, state hy. engr., Austin, and A. R. Losh, state hy. engr., Oklahoma City, Okla., 1,909 ft. steel, concrete bridge over Red River, Hy. 51, between Hardeman Co., Tex., and Jackson Co., Okla.

**Texas**—Sept. 15, by G. Gilchrist, state hy. engr., Austin, rein.-con. bridges on Hy. 1, Federal Aid Project 558-D, Unit 1, Culberson Co. $44,000.

**Tex., Pt. Isabel**—General Eng. & Development Corp., Flat Iron Bldg., New York, taking sub-bids 10,400 lin.ft. causeway over Lagoon Madre to Padre Island, for Pt. Isabel Bridge Co., c/o H. H. Poshong, pres., Pt. Isabel. Furnishing 1,000,000 ft. lumber for above causeway, to Chas. R. McCormick Lumber Co., Yeon Bldg., Portland, Ore. Noted Aug. 15 under "Contracts Awarded."

**Ontario**—Sept. 17 (extended date), by R. M. Smith, deputy minister, Dpt. P. Hys., Parliament Bldgs., Toronto. Paris Bridge, Contr. 30-75. Noted July 17.

**Ont., Hamilton**—Sept. 17, by S. H. Kent, city clk., c/o J. Peebles, mayor, chn. Bd. Control, City Hall, 250 ft. low level bridge, 40 ft. roadway over Desjardins Canal. W. L. McFaul, city engr.

### CONTRACTS AWARDED

**Ill., Chicago**—Bd. Comrs. Lincoln Park, Clark and Center Sts., superstructure North Approach Outer Dr., Impvt. from north line East Grand Ave. to south line North Pier Terminal Building, to Paschen Bros., Inc., 33 North La Salle St., (a) 3½ in. asphaltic pavement $250,900 (b) 2 in. asphalt block pavement $258,585. Bids soon substructure and superstructure for main bridge. H. E. Young, 208 West Washington St., consult. engr. Noted Aug. 7.

**Iowa**—State Hy. Dpt., Ames, bridges, culverts in Guthrie Co., to B. Cole & Son, Ames, $76,040—Howard Co., to F. Russell & Son, Waukon, $1,767—Keokuk Co., to W. Denny, West Liberty, $1,970—Linn Co., to J. B. Elliott, Independence, $10,800—Monona Co., to A. Olson Constr. Co., Waterloo, $35,442—Monona Co., to Duvall & McKinney, Logan, $8,911—Monona Co., to B. O. Dorn, South Sioux City, Neb., $4,325—Monona Co., to C. R. Yeggs, Boone, $9,200. Grand total $148,455. Noted Aug. 28.

**Ia., Mt. Pleasant**—Henry Co., two 80 x 18 ft. pony truss bridges, on concrete abutments, one with wood flooring other with concrete flooring, to A. J. Johnson, Lockridge, and G. A. Zika & Son, Ottumwa, $4,987 and $8,888 respectively. Noted July 24.

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Bridges (Continued)

**Maine**—State Hy. Dpt., Augusta, constructing Androscoggin Bridge, to Boston Bridge Wks., Inc., Binney St., Cambridge, Mass., $43,151—Walton Mill Bridge, Mt. Vernon, to U. Netevier, Rumford, $7,044 — Sinclair and Creamery Bridges, Lebanon, to Badger Rand Ice Co., 1 Cate St., Portsmouth, N. H., $4,214 and $3,985 respectively—Hussey Bridge, Albion, to C. McNally, Ellsworth, $3,790. Grand total $62,184.

**Maryland**—State Rds. Comn., Baltimore, extending triple span arch bridge, Contr. W-70-67, Washington Co., to F. G. Gregory, Sutherland, Va., $15,618. Noted Aug. 7.

**Md., Baltimore**—Bd. Awards, altering east approach Lee Street Bridge over Baltimore & Ohio R.R., to Mullan Contg. Co., 3945 Greenmount Ave., $29,360. Noted Aug. 14.

**Mo., St. Joseph**—Buchanan Co., grading, culverts 19.1 mi. road from Rushville to Gower, to Consolidated Paving & Material Co., 7th and Olive Sts., $79,550.

**Mo., Webster Groves**—St. Louis Co. and St. Louis & San Francisco Ry., F. G. Jonah, ch. engr., St. Louis, 90 ft. rein.-con. bridge, 46 ft. over Laclede Station Rd. and Frisco tracks, to Hedges-Week Constr. Co., Holland Bldg., Springfield, $20,000.

**Montana**—State Hy. Comn., Helena, bridges in Broadwater and Hill Counties, to W. K. Trippet, Whitefish, $16,973 and $9,868 respectively—4 bridges in Powell Co., to P. W. Hastings Co., Billings, $26,083—bridges in Cascade Co., to McGuire & Blakeslee, Great Falls, $13,275—Dawson Co., to Mackin & Berg, Brockway, $23,535—Gallatin Co., to D. J. O'Neil & Son, Livingston, $4,178. Grand total $93,912.

**New Jersey**—Bd. Freeholders Ocean and Monmouth Counties, Court House, Freehold, 50 ft. rein.-con., steel bridge over Metedeconk River, on Squankun-Lakewood Rd., Larrabees Crossing, to S. S. Thompson Co., 190 Monmouth St., Red Bank. Est. $30,000.

**New Jersey**—State Hy. Dpt., Trenton, constructing Route 4 Sect. 7, Passaic River Bridge and approaches, Paterson to East Paterson, Passaic and Bergen Counties, to Magri & Schoonover, 120 York Ave., Paterson, $443,633. Noted Aug. 21.

**N. J., Union Beach** (br. Keyport)—Bd. Freeholders Monmouth Co., Court House, Freehold, rein.-con. steel bridge, Florence and Union Aves., to S. S. Thompson Co., 190 Monmouth St., Red Bank. Est. $25,000. Noted June 19.

**Ohio**—B. N. Waid, dir. hys., Columbus, steel truss bridge, Brown Co., to Dodge-Hussey Co., Columbus, $53,112 — concrete beam bridge, Franklin Co., to C. R. Boulton, 10 East Town St., Columbus, $31,788—Ottawa Co., to W. A. Yeagle, Clyde, $63,631. Grand total $148,531. Noted Aug. 21.

**Okla., Tulsa**—Rein.-con. viaduct on Boston Ave., to H. L. Cannady Co., 1116 South Lewis St., $130,728. Est. $153,553. Noted July 3.

**Pennsylvania** — State Hy. Dpt., Harrisburg, bridges in Huntingdon Co., to York Eng. & Constr. Co., York, $41,948—Lawrence Co., to Whittaker & Diehl, Harrisburg, $115,754 — Lehigh and Northampton Counties, to Parker & Graham, Inc., 5 Colt St., Paterson, N. J., $253,341. Grand total $411,043. Noted Aug. 7, under "Streets and Roads."

**Pa., Connellsville**—Pittsburgh & West Virginia R.R., H. H. Temple, ch. engr., Wabash Bldg., Pittsburgh, grading, sub-structure for bridge over Youghiogheny River, to Vang Constr. Co., Grant Bldg., Pittsburgh, $1,500,000—through truss bridge, combination girder spans, trusses, over Youghiogheny River, to American Bridge Co., Frick Bldg., Pittsburgh. $200,000.

**Tennessee**—See "Streets and Roads."

**Tennessee**—State Dpt. Hys. & P. Wks., Nashville, concrete, steel bridge over Clinch River, on State Hy. 1, Federal Aid Project 85-B, near Kingston, Roane Co., to Shields Constr. Co., Hazard, $158,668.

**Tex., Pt. Isabel**—See "Bids Asked."

**Vermont**—Hy. Dpt., Montpelier, 70 ft. I-beam bridge over White River, to D. S. McGrath, Inc., Center St., Adams, Mass., $11,215. Noted Sept. 4.

**Virginia**—See "Streets and Roads."

**West Virginia**—State Hy. Comn., Charleston, substructure for Bridges 1225 and 1227 concrete, steel, Greenbrier Co., to Clark & Lewis, Luray, $4,872 and $6,747 respectively—Bridge 1219, Ritchie Co., to A. B. Peraldo & Son, Jaeger, $7,589—Bridge 1198, Summers Co., to J. M. Francesco, Fayetteville, $3,189—superstructures Bridge 1225, Greenbrier Co. to N. H. Clark, Luray $10,460—Bridge 1227, Greenbrier Co. to Wheeling Structural Steel Co., Wheeling, $14,000—Bridge 1198, Summers Co., to Vincennes Bridge Co., Vincennes, Ind., $5,480 — Bridge 1228, concrete, timber, steel, Greenbrier Co., to Concrete Steel Bridge Co., Clarksburg, $21,125—Bridge 1219, Ritchie Co., to E. R. Mills, Charleston, $5,995. Grand total $79,817. Noted Aug. 15.

**Ont., Hamilton**—See "Streets and Roads."

**Ont., Hamilton** — Temiskaming & Northern Ontario Ry., S. B. Clement, ch. engr., North Bay, bridge over Moose River, to Hamilton Bridge Co., Hamilton, $300,000.

**Ont., Welland**—Dpt. P. Wks., Ottawa, bridge, to Canadian Bridge Ltd., Walkerville, $400,000.

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## STREETS AND ROADS

### BIDS ASKED

**Arizona** — Sept. 22, by State Hy. Comn., Phoenix, grading, placing sub-grade stabilizer on 7.4 mi. Ashfork-Kingman Hy. F. A. P. 80-D. W. W. Lane, state engr.

**California**—Sept. 24, by State Hy. Comn., Sacramento, gravel base surfacing 8.1 mi. Williams-Maxwell Rd., Colusa Co.—grading, untreated crushed gravel or stone surfacing 1.7 mi. Clarks Corner-Placerville Rd.—grading, concrete paving 0.9 mi. road through South San Francisco—grading 0.8 mi. Westerly Boundary-Burnt Ranch Rd. C. H. Purcell, P. Wks. Bldg., engr.

**Calif., San Francisco**—Sept. 17, by S. J. Hester, secy. Bd. P. Wks., City Hall, improving Sect. D—Sunset Blvd., incl. 133,600 cu.yd. excav., 61,700 cu.yd. imported borrow, 195,000 sq.ft. 2½ in. asphaltic concrete on 10 in. waterbound macadam paving $123,000. M. M. O'Shaughnessy, city engr.

**Calif., San Rafael**—E. W. Smith, city clk., taking bids grading, curbing, guttering, walks, sewers, 5 in. hydrated concrete on 4 in. stone sub-base paving 59,750 sq.ft. 2nd St.: grading, curbing, guttering, sewers, 5 in. hydrated concrete on 4 in. rock sub-base paving 25,000 sq.ft. Mission Ave.

**Delaware**—Sept. 23, by State Hy. Dpt., Dover, slag surfacing 2.4 mi. Whitehall Neck Rd., Contr. 133—clearing, grubbing, grading, concrete paving 4.38 mi. Providence Church-Columbia Rd., Contr. 142—3.6 mi. Greenwood-Scott Store Rd., Contr. 150—grading, slag base course surfacing 1.2 mi. Williamsville-Bayville Rd., Contr. 163—surface treating 4.2 mi. Townsend-Dexters Corner Rd., Contr. 170.

**Idaho**—Sept. 16, by J. D. Wood, comr. P. Wks., Boise, grading, graveling, 5.448 mi. Sawtooth Park Hy. between Richfield and Pagari, Lincoln Co.

**Ind., Versailles**—Sept. 15, by Bd. Comrs. Ripley Co. concrete surfacing 3.46 mi. J. W. Harvey Rd. and 3.67 mi. C. D. Miller Rd. $37,205. H. W. Behlmer, chn.

**Iowa**—Sept. 16, by State Hy. Comn., Ames, grading, flumes, paving 0.43 mi. Rd. 117, P-532, Jackson Co.—0.734 mi. Rd. 46, P-14 and 1 mi. Rd. 46, P-706, Carroll Co.—grading 0.742 mi. Rd. 7, P-691, Guthrie Co.—0.701 mi. Rd. 65, P-642, Hardin Co.—3.698 mi. Rd. 13, P-687, Jones Co. — 2.232 mi. P-604, O'Brien Co. — 12.706 mi. Rd. 4, P-615, Pottawattamie Co.—gravel surfacing 6.781 mi. Rd. 153, P-581, Jones Co.—36,140 ft. cable guard rail, 38 anchors and rounding 3,000 posts in guard rail Project Dist. 2, various counties—6 culverts, extensions on Rd. 7, B-691, Guthrie Co. — raising approach spans to present Wabash Railroad Crossing at Council Blus, Rd. 34, X-384, Pottawattamie Co. R. F. White, ch. hy. engr.

**Ia., Afton** — Sept. 15, by Town, c/o T. S. Spencer, clk., grading, curbing, guttering, concrete paving 6,300 sq.yd., various types paving 5,100 sq.yd., 12,500 to 25,000 lb. reinforcing steel. P. K. DeVoe, town engr.

**Kentucky** — Sept. 23, by State Hy. Dpt., Frankfort, grading, drainage structures, traffic bound limestone, waterbound macadam, crushed limestone, or traffic bound river gravel surfacing 0.65 mi. Elizabethtown-Munfordsville Rd., Federal Aid Project 168-C-S, Hardin Co. B. Johnson, chn.

**Louisiana**—Sept. 16, by State Hy. Comn., Baton Rouge, grading, drainage structures 5.17 mi. Tannehill-Cypress Creek Hy., Winn Parish; 8.94 mi. Harrisburg-Enterprise Hy., Project 684-C, Route 68, Catahoula Parish. H. B. Henderlite, ch. hy. engr.

**Louisiana** — Sept. 30, by State Hy. Comn., Baton Rouge, preparing sub-grade, dressing shoulders, gravel or shell surfacing 10.63 mi. Baton Rouge-New Orleans Hy., Project 1202-A, Ascension Parish—concrete surfacing 7.48 mi. Cheneyville-Bunkie Hy., Project 1401, Route 1, Avoyelles and Rapides Parishes. W. H. Norckauer, hy. engr.

**Maine**—Sept. 18, by State Hy. Comn., Augusta, concrete paving 7.56 mi. Federal Aid Project 121-E, Yarmouth and Freeport; gravel surfacing 2.08 mi. State project, Prospect. L. D. Barrows, ch. engr.

**Mass., Haverhill**—See "Contracts Awarded."

**Mass., Malden** (br. Boston)—Soon takes new bids warrenite bitulithic or equivalent paving 14,700 sq.yd. Cross, Bryant and Franklin Sts. Former bids rejected.

**Mass., Worcester**—See "Contracts Awarded."

**Michigan**—Sept. 17, at office H. C. Fleming, resident engr., 213 Watson Bldg., Grand Rapids, gravel on crushed rock or gravel surfacing 4.009 mi. MO64-8 Contr. 1, Oceana Co., for State Hy. Comn., Lansing.

**Michigan**—Sept. 18, at office C. H. Brown, resident engr., 14380 Wyoming Ave., Highland Park, grading, 20 ft. concrete paving 6.102 mi. Ass. Dist. 475 Contr. 2, Macomb and Wayne Counties, for State Hy. Comn., Lansing.

**Michigan**—Sept. 25, at office G. H. Greene, resident engr., Alpena, grading, concrete paving 6.103 mi. Fo6-18 Contr. 1, Arenac Co.; 5.5 mi. Fo65-12 Contr. 1, Ogeman Co., each 20 ft., for State Hy. Comn., Lansing.

**Minnesota**—Sept. 23, by State Hy. Dpt., St. Paul, grading 8.5 mi. S.P. 9-40—5.9 mi. S.P. 20-27—10.1 mi. S.P. 20-37—17.3 mi. S.P. 70-21. Engineering Dpt. Owner, 1246 University Ave., St. Paul, engrs.

**Miss., Kosciusko**—Sept. 18, by Com. of Mc-Adams, Sallis and Bodone Separate Road Dist., Attalia Co., graveling 12 mi. roads.

**Mo., St. Louis**—Sept. 30, by Bd. P. Serv., City Hall, grading, concrete paving Hampton Ave., Chippewa St., and City Block 2882, $75,680. W. W. Horner, city engr.

**New York**—Sept. 30, by A. W. Brandt, comr. P. Wks., State Office Bldg., Albany, constructing hys. in Ulster, Washington, Westchester, and Wyoming Counties; reconstructing hys. in Dutchess, Erie, Herkimer, Rensselaer, Suffolk, Tompkins and Westchester Counties; adv. E. N.-R. Sept. 11.

**N. Y., Brooklyn**—Sept. 18, by H. Hesterberg, pres. Brooklyn Boro. Boro Hall, asphalt on 6 in. concrete repaving Prospect Pl., Himrod, Powell, Sackett, Vermont, and 90th Sts., Jefferson, Waverly, Willoughby Aves., grading, curbing, flagging Avenue N.

**N. Y., New York**—Sept. 16, by H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., grading, curbing, Boyd and Hobart Aves.—granite block on concrete paving 243rd St.—sheet asphalt on concrete paving Barnes, Blondell, Roberts and Jarvis Aves., East 172nd, McClellan, Barretto Sts.

**O., Chardon**—Sept. 15, by Comrs. Geauga Co., E. L. Thrasher, clk., grading, waterbound macadam paving 1.73 mi. Parkman-Nelson Rd., 18 ft. $27,269.

**O., Cleveland**—Sept. 13, by Cuyahoga Co., slag and tarvia surface treating 112,855 sq.yd. Wooster Pike, est. $22,571. 4,723 sq.yd. Wilson Mills, est. $8,503. F. Williams, Court House, co. engr.

**O., Euclid** (br. Cleveland) — Sept. 15, by Village, sidewalks, paving East 254th St., and 3 streets in Idlewild Beach Subdivision, $40,000. F. R. Thomas, Town Hall, engr.

**O., Lisbon**—Comrs. Columbiana Co. bids about Sept. 22, resurfacing 4.907 mi. Valley-Salem Rd., 20 ft. $114,979. L. G. Kirk, Lisbon, engr.

**O., Wilmington** — Comrs. Clinton Co. bids about Nov. 4, grading, gravel and slag surfacing 28 mi. secondary roads, 16 ft. $30,000.

**Pa., Duquesne**—Sept. 15, by J. A. Hughes, supt. Streets & Pub. Impvts., City Hall, grading, curbing, paving North 1st St. between Hamilton Ave. and traffic circle, $25,000; regrading, recurbing, repaving Hamilton Ave. between Plum Alley and North 4th St., $35,000. R. B. Dell, Municipal Bldg., engr.

**Pa., Phila.**—Sept. 16, by Dpt. P. Wks., Bureau Hys., A. Murdock, dir., City Hall Annex, improving, grading Overhill Ave.—asphalt paving—improving country roads.

**Pa., Pittsburgh**—Sept. 16, by R. G. Woodside, controller Allegheny Co., rein.-con. paving 2,857 ft. Interboro Ave., 27 to 36 ft. $65,500; 7,494 ft. Glassport-Elizabeth Rd., 20 ft. $161,000. E. A. Griffith, 519 Sheffield St., engr.

**Texas**—Sept. 15, by G. Gilchrist, state hy. engr., Austin, grading, drainage structures 19.792 mi. Hy. 70, Fisher and Nolan Counties, 26 ft., $100,000; concrete paving 4.191 mi. Hy. 28, Cottle Co., 18 ft., $100,000.

**Texas** — Sept. 15, by G. Gilchrist, state hy. engr., Austin, grading, drainage structures 13.021 mi. hy. Culberson Co., $60,000—5.083 mi. Ellis Co., $42,000—10.875 mi. Hutchinson Co., $25,000—10.471 mi. Upton Co., $116,000, all foregoing 26 ft. wide—rein.-con. paving 3.783 mi. hy. Navarro Co., 18 ft., $100,000.

**Texas**—Sept. 16, by G. Gilchrist, state hy. engr., Austin, grading, drainage structures 19.672 mi. hy. Hansford Co., $40,000—17.99 mi. Ochiltree Co., $38,000—2.313 mi. Dallas Co., $25,000, all foregoing 26 ft. wide—asphalt surfacing 15.424 mi. hy. Throckmorton Co., $100,000, 18 ft.

**Texas**—Sept. 16, by G. Gilchrist, state hy. engr., Austin, grading, drainage structures 2.313 mi. Dallas Co., $54,000—12.271 mi. Fisher Co., $66,000—19.197 mi. Refugio Co., $120,000, all foregoing 26 ft.—grading, drainage structures, triple bituminous on gravel surfacing 3.186 mi. Hall Co., 18 ft., $56,000.

**Wash., Colfax**—Sept. 15, by Comrs. Whitman Co., crushed rock surfacing 10,000 cu.yd., culvert and bridge work on Permanent Hy. 30, $40,000. L. R. Sampson, Colfax, engr.

**West Virginia** — Sept. 23, by State Road Comn., Charleston, grading, surfacing 63.48 mi. roads in Berkeley, Doddridge, Greenbrier, Hancock, Jackson, Jefferson, Lincoln, Monongalia, Monroe, Pocahontas and Tyler Counties; bridges, culverts in McDowell, Ritchie and Greenbrier Counties. G. E. White, secy.; adv. E. N.-R. Sept. 11.

**Wisconsin** — Sept. 16, by State and Oneida Co. Hy. Comns., Court House, Rhinelander, constructing Antigo-Eagle River Rd., S.T.H. 26, F.A.P. 380-B and C; also Gagen Overhead, Project 380-C.

**Wisconsin**—Sept. 19, by State and Eau Claire-Trempealeau and St. Croix Counties Hy. Comn., 213 South Barstow St., Eau Claire, grading bridging 18.371 mi. Osseo-Eau Claire Rd., U. S. Hy. 53, F.A.P. 368-C and D, Eau Claire and Tremplealeau Counties; graveling 1.6543 mi. Stillwater-Somerset-New Richmond Rd., S.T.H. 64, S.A.P. 6994, St. Croix Co.

**Ont., London**—See "Contracts Awarded."

**Ont., Orillia**—Sept. 12, by James, Proctor & Redfern, engrs., 36 Toronto St., Toronto, alternate types paving 8,500 sq.yd. Barrie Rd. and Coldwater St., for Town. $40,000.

### CONTRACTS AWARDED

**Ark., Pine Bluff**—District Comrs. at office Coleman & Gantt, attys., Simmons Natl. Bldg., curbing, concrete paving 90,000 sq.yd. Street Impvt. Dist. 105 (5th, 6th and Ohio Sts.), to Fry Bros. Constr. Co., Marshall, Tex. and Iola, Kan., $151,333.

**Calif., Arcadia**—Grading, culverts, 6 in. concrete paving 950,000 sq.ft. Huntington Dr., to Osborn Co., 450 California Terrace, Pasadena $130,405.

**Streets and Roads (Continued)**

**Calif., Richmond**—A. C. Feris, city clk., grading, curbing, asphaltic concrete on rock paving Pullman Ave., to Union Paving Co., Call Bldg., San Francisco, $132,127. Noted Aug. 14.

**Calif., San Diego**—Common Council, grading, curbing, guttering, walks, watermains, sewers, ornamental lighting, 6 in. concrete paving 138 sq.yd., 6 in. asphaltic concrete paving 41,041 sq.yd., La Jalla Mesa Dr., et al., to R. E. Hazard Constr. Co., 2548 Kettner Blvd., $197,280. Noted Aug. 28.

**Idaho**—J. D. Wood, comr. P. Wks., Boise, grading, surfacing 7.793 mi. Idaho Central Hy., Camas Co., to Western Constr. Co., Pocatello, $55,050 — 8.085 mi. Yellowstone Park Hy., Franklin Co., to O. Nelson, Logan, Utah, $91,708—grading 24.097 mi. Old Oregon Trail, Power and Cassia Counties, to W. Hoops, Twin Falls, $117,202. Grand total $263,960. Noted Aug. 11.

**Ill., Chicago**—Bd. Local Impvts., City Hall, removing old paving, guttering, masonry and grading, curbing, guttering, sewers, asphalt on 8 in. concrete and granite block paving South Western Ave., to R. F. Conway Co., 844 Rush St.—widening, removing old paving, curbing and masonry, cleaning concrete foundation, preparing sub-grade, curbing, guttering, sewers, new and old granite block and asphalt on old concrete paving North Western Ave., to Ready Coal & Constr. Co., 205 West Wacker Dr.—widening, removing old paving, curbing and masonry, preparing sub-grade, old and new granite block, asphalt on concrete paving, old concrete brought to grade with additional concrete on North Western Ave., to J. A. McGarry & Co., 189 West Madison St., total est. $1,400,000. Preparing sub-grade, curbing, guttering, sewers, old and new granite block, asphalt wearing course and binder paving North Ashland Ave., to J. M. Bransfield, 3525 South Leavitt St.—Harlem Ave., to Marquette Constr. Co., 5726 North Winchester St.—grading, curbing, guttering, sewers, asphalt on 6 in. concrete paving West 63rd and 64th Places, West 64th and Atgeld Sts., Catalpa, South Mayfield and South Austin Aves., to Barber Paving Co., 7 South Dearborn St.—East 86th, 127th, 128th and 129th Places, East 86th, West 73rd, 127th, 128th and 129th Sts., Homewood, South Oakley, Vernon, Rhodes, Parnell, Normal, Eggleston, South Sawyer, South Spaulding, Turner and South Homan Aves., to American Asphalt Paving Co., 120 South La Salle St.—grading, curbing, guttering, sewers, 8 and 10 in. concrete paving Diversey Ave., to J. A. Ross & Co., 4361 Armitage Ave.—West 13th Pl., to John Dillon & Co., 2953 South Halsted St.—Altgeld St., North Parkside, North Major and Wrightwood Aves., to J. A. Sackley Co., 4608 Belmont Ave.

**Iowa**—State Hy. Dpt., Ames, grading, flumes, paving 1.789 mi. roads in Fremont Co., to Roberts Constr. Co., 404-5 1st Natl. Bank Bldg., Lincoln, Neb., $42,234—0.253 mi. Marshall Co., to Carlson Constr. Co., Marshalltown, $8,933—0.552 mi. Mills Co., to Moran Constr. Co. 2431 Ellison St., Omaha, Neb., $15,309—1.837 mi. F-303 and 0.405 mi. F-276 Tama Co., to G. G. Herrick, 540 46th St., Des Moines, $44,406 and $11,102 respectively—grading 0.152 mi. Boone Co., to A. F. McMahan, Iowa City, $1,963—1.905 mi. Koekuk Co., to F. B. Ryan, Charlton, $7,890—4.864 mi. Linn Co., to W. Dutton, Boone, $37,262—gravelling 4 mi. Mills Co., to W. T. Kelley, Des Moines, $7,274—21.703 mi. Plymouth Co., to J. Schumacher, Bancroft, $16,774—281.830 ft. guard rail in Dist. 9, to Lee & Johnson, Hampton, $46,574. Grand total $239,721. Noted Aug. 28.

**Kansas** — State Hy. Comn., Court House, Stockton, to Yancey Constr. Co., Abilene, improving 6.348 mi. Federal Aid Project 286-D grading, culverts $23,928, bridge $2,067; 5.237 mi. Federal Aid Project 371-F, grading, culverts $29,927, 4 bridges $27,594. Grand total $83,516.

**Kan., Kansas City**—For 3 in. brick on 8 in. concrete paving State Avenue Traffic Way, to Tobin Constr. Co., 226 West 39th St., $107,070—Central Ave., to E. J. Watterstrom, 3561 Bway., $7,819—rock asphalt surfacing Central Avenue Traffic Way, to T. J. Thompson, 3908 Forest Ave., $57,737—sewers in Dists. 9 and 10, to G. A. Luther, 1016 Greeley St., $1,644 and $4,106 respectively. Grand total $178,376. Soon takes new bids paving State Avenue Traffic Way, Shawnee Rd., 37th, 6th and 19th Sts.

**Maryland**—State Roads Comn., Baltimore, graveling 1 mi. Contr. Ch-83-84, Charles Co., to Jarboe & Haughton, Mechanicsville, $5,547; bitulithic concrete paving 2.1 mi. Contr. P-133-311, Prince George Co., to Highway Eng. & Contg. Co., 7th and T Sts. N.E., Wash., D. C., $16,862.

**Maryland**—State Roads Comn., Baltimore, concrete paving 1.87 mi. Contr. P-127-34, Prince George's Co., to G. B. Mullin Co., 1296 Upshur St., Wash., D. C., $38,690. Noted Aug. 7.

**Maryland**—State Roads Comn., Baltimore, concrete shoulders 2.14 mi. Contr. M-149-511, Montgomery Co., to M. J. Grove Lime Co., Lime Kiln, $15,745. Noted July 10.

**Maryland**—State Rds. Comn., Baltimore, concrete paving 1.9 mi. Somerset Co., to P. D. Phillips & Bro., Salisbury, $66,755. Noted Aug. 28.

**Maryland**—State Rds. Comn., Baltimore, concrete paving 1.3 mi. Frederick Co., to M. J. Grove Lime Co., Lime Kiln, $39,457; concrete shoulders on 1.6 mi. Baltimore Co., to P. Reddington & Son, 2 East Lexington St., Baltimore, $27,025. Noted Aug. 21.

**Massachusetts** — Commonwealth of Massachusetts, Dpt. P. Wks., Boston, bituminous macadam paving 3,900 ft. hy., Rockport, to South Shore Constr. Co., 39 Swanton St., Winchester, $19,223—rein.-con. paving 2,356 ft Andover, to P. J. Holland, 24 Ames St., Lawrence, $23,905—bitulithic concrete paving 1,237 ft. and bitulithic paving 2,549 ft. Swampscott, to M. McDonough Co., Swampscott, $9,625 and $8,640 respectively — bituminous macadam and rein.-con. paving 11,663 ft. Avon and Brockton, to Powers Bros., 167 North Montello St., Brockton, $147,733. Grand total $209,126.

**Massachusetts**—Metropolitan Dist. Comn., 1 Ashburton Pl., Boston, resurfacing Memorial Dr., Cambridge, to John McCourt Co., 910 Huntington Ave., Boston; South Border Rd., Medford and Winchester, to M. McDonough Co., 821 Bway., Saugus, $41,650.

**Mass., Boston**—Dpt. P. Wks., sheet asphalt paving streets in Wards 11 and 20, to Dooley Bros., 73 Howard St., Roxbury, $21,921 — bitulithic paving Harrison Ave., Ward 3, to S. J. Tomasello, 15 Bay St., Dorchester, $16,988. Est. $25,000 each.

**Mass., Boston**—Dpt. P. Wks., J. A. Rourke, comr., sheet asphalt paving Hanson, Upton and Middlesex Sts., to A. R. Doyle, 121 Boston St., Dorchester, $22,345. Est. $25,000.

**Mass., Boston**—Dpt. P. Wks., J. A. Rourke, comr., artificial stone sidewalks on Tremont St., to W. G. C. Co., 27 School St., $14,677—Huntington Ave., to A. G. Tomasello, 250 Stuart St., $16,815—Worcester Sq., to C. Repucci, 10 Garden Court St., $11,911. Grand total $43,403.

**Mass., Haverhill**—Reconstructing and hot top resurfacing Keeley St., separate contracts, $25,000. G. L. Martin, City Hall, hy. comr.

**Mass., Medford** (br. Boston)—Constructing roads, to J. A. Gaffey, 19 James St., $48,158. Noted Aug. 21.

**Mass., Worcester**—Asphaltic macadam paving Commodore Rd., $21,500—Copperfield Rd., $13,130—Westfield St., $8,895—Howland Terrace, $25,071—Greendale Ave., $20,000—Cohasset St., $12,000, day labor. Grand total $100,596.

**Michigan** — R. A. Beers, resident engr., Kalamazoo, grading, concrete paving 3.221 mi. MO11-17C-1, 20 ft., Berrien Co., to John R. Edelman Co., Muskegon Heights, for State Hy. Comn., Lansing, $110,913 incl. cement. Noted July 17.

**Michigan**—E. R. Benkert, resident engr., Port Huron, grading, concrete paving 10.931 mi. FO77-32, Contr. 1, 20 ft., St. Clair Co., to J. H. Baker & Sons, Port Huron, for State Hy. Comn., Lansing, $347,293 incl. cement. Noted Aug. 15.

**Michigan**—C. H. Brown, resident engr., Highland Park, grading, shaping, two 20 ft. concrete slab surfacing 2.663 mi. road in Assessment Dist. 474, Contr. 2, Ashland and Wayne Counties, to Smith Paving Inc., 6444 Michigan St., Detroit, for State Hy. Comn., Lansing, $247,618 incl. cement. Noted July 17.

**Michigan** — E. D. Crandall, resident engr., Cadillac, sheet asphalt on gravel surfacing 5.826 mi. MO28-20, Contr. 5, and 6.101 mi. M028-21, Contr. 2, both 18 ft., Grand Traverse Co., to Detroit Asphalt Paving Co., 909 Transportation Bldg., Detroit, $57,044 and $57,379 respectively, for State Hy. Comn., Lansing. Noted Aug. 15.

**Michigan** — H. I. Davies, division engr., Escanaba, grading, concrete paving 3.555 mi. FO21-9, Contr. 2, Delta Co., 20 ft., to Bacco Constr. Co., Iron Mountain, for State Hy. Comn., Lansing, $100,923 incl. cement.

**Miss., Kosciusko**—For 2 in. warrenite on 5 in. concrete paving Jefferson St., to Barber Bros. Concrete Co., Bogalusa, La., $26,010.

**Montana** — State Hy. Comn., Helena, grading 7.606 mi. Hill Co., and 12.81 mi. Cascade Co., to Tomlinson-Arkwright Constr. Co., Great Falls, $19,268 and $24,437 respectively—6.113 mi. Gallatin Co., to D. J. O'Neill & Son, Livingston, $41,739—9.356 mi. Powder River Co., to J. E. Hilton & Sons, Miles City, $41,828—11.899 mi. Broadwater Co., to L. T. Lawler, Butte, $63,803 — 12.891 mi. Dawson Co., to Powers Constr. Co., Helena, $62,572 — blade grader work 16.066 mi. Power River and Carter Counties, to N. J. Olson, Scenic, S. D., $8,418—improving 0.419 mi. Park Co., to J. L. McLaughlin, Livingston, $10,379—warrenite bitulithic paving 0.548 mi. Cascade Co., to S. Birch & Sons Constr. Co., Great Falls, $23,488—surfacing 13.982 mi., Phillips Co., to Syster & Rathbun, Shelby, $42,258. Grand total $338,190. Noted Aug. 21 Daily.

**New Jersey**—State Hy. Comn., Trenton, grading bituminous concrete paving 12,873 sq.yd. 10 in. rein.-con. paving 141,573 sq.yd. Routes 1, 4, 6, Sect. 6, Christie's Lane to Hudson River Bridge Plaza, Bergen Co., to G. M. Brewster, Bogota, $1,547,418. Noted Aug. 7.

**N. J., Westfield**—Town Council, town Hall, 9 in. rein.-con. paving North Ave., to Weldon Contg. Co., Broad St., $48,859. Est. $60,000. Noted Aug. 21.

**N. Y., Mineola** — Nassau Co., improving Mineola Blvd., to Hinkle & Finlayson, Cedar Swamp Rd., Glen Cove, $63,485—Pennsylvania Ave., Roosevelt and New Hyde Rd., Franklin Sq., to A. Weston, Inc., Inwood, $38,330 and $27,463 respectively—Nassau Rd., Roosevelt, to Balcort General Contg. Co., $12,392—Main St., Port Washington, to Crampton Bros., East Shore Rd., Great Neck, $46,988—Washington Ave., Roosevelt, to Good Roads Constr. Co., Burns Ave., Belmar, $51,225; Henry and Clinton Sts., Hempstead, to Standard Bithulithic Co., Commercila Ave., Garden City, $,720. Grand total $24,603.

**Ohio**—R. N. Waid, dir. hys., Columbus, concrete paving 1.337 mi. Allen Co., to G. B. Walther, Lima, $28,909—4.139 mi. Lawrence Co., to Ray Strawser Constr. Co., 852 North Cassedy Ave., Columbus, $190,859—0.32 mi. Mahoning Co., to P. T. McCourt Constr. Co., 369 South Main St., Akron, $16,100 — 1.753 mi. Ottawa Co., to Wahl Products & Constr. Co. Vickery, $40,136—5.227 mi. Sandusky Co., to Modern Constr. Co., Fremont, $138,884—concrete paving, curbing, guttering 0.799 mi. Belmont Co., and brick paving, incl. furnishing delivering brick 2.048 mi. Jefferson Co., to Eberbach Constr. Co., Pomeroy, $41,480 and $180,747 respectively—1.387 mi. Lucas Co., to G. L. La Boiteaux, 4926 Lewis St., Toledo, $139,758—waterbound macadam paving 0.682 mi. Fayette Co., to Elsass-Myer Co., Anna, $32,994 — bituminous macadam paving 0.43 mi. Marion Co., to W. J. Fitzgerald, Lima, $37,307—curbing, guttering, sheet asphalt paving 1.09 mi. Belmont Co., to Swingle, Robinson & Burns, Columbus, $46,448 — grading, drainage structures 1.799 mi. Brown Co., to Dodge-Hussey Co., Columbus, $20,736. Grand total $914,158. Noted Aug. 21.

**O., Cincinnati**—Hamilton Co. asphalt bound macadam repaving Drake Rd., to A. M. Slone, Drake Rd., $22,025. Est. $29,610.

**O., Cleveland** — Asphalt paving Astor and Plainfield Aves., West 179th and West 17th Sts., to Cleveland Trinidad Paving Co., Western Reserve Bldg., $47,758.

**O., Massillon**—Repaving, resurfacing 1st St. N.E. to Urban Bros. Co., Massillon, $48,337. Est. $50,000.

**O., Mount Gilead**—Comrs. Morrow Co., traffic bound macadam paving 11 mi. Lincoln-Cardington Rd., 18 ft., to Kersting & Mayor, Ottawa, $26,311.

**O., Parma** (br. Cleveland) — Village, paving Stanbury, Lorimer and Dresser Aves., to Baldwin Bros., Union Trust Bldg., Cleveland, $60,000. Noted Aug. 7.

**O., South Euclid** (br. Cleveland) — Village sheet asphalt paving Dorsh Rd., to Howard G. Herring, Wayside Rd., Cleveland, $43,925.

**O., South Euclid** (br. Cleveland)—Village, to Rieley Bros., The Arcade, Cleveland, brick paving Wrenford Rd., $9,313; asphalt paving Reis Rd., $13,060; Wood Rd., $13,802. Grand total $36,175.

**Okla., Arapaho**—Custer Co., grading, drainage structures 12.642 mi. Hy. 5, Project 204, Sects. A and B, to Maney & Allen, Empire Bldg., Oklahoma City, $88,727.

**Okla., Oklahoma City** — Grading, paving 7 blocks 3rd St., and 4 blocks Shartel St., to Western Paving Co., Petroleum Bldg., $40,325 and $34,458 respectively. Est. $43,000 and $40,000 respectively.

**Pennsylvania** — State Hy. Dpt., Harrisburg, concrete surfacing 16,046 sq.yd., bituminous surface treated waterbound macadam surfacing 7,880 sq.yd. Perry and North Mahoney Twps., Jefferson and Indiana Counties to J. S. Teeter, Taneytown, Md., $60,959—grading, concrete surfacing 6,627 sq.yd., bituminous surface treated waterbound macadam surfacing 2,429 sq.yd. Young Twp., Jefferson Co., to A. R. Cooper, Idamer, $38,667 — grading, concrete surfacing 5,400 sq.yd. Kelly and White Deer Twps., Union Co., to A. A. White, Inc., Lebanon, $21,320—20,600 sq.yd. Peninsula and Misery Bay Dr., Erie Co., to C. H. Fry Co., Erie, $118,019—18,150 sq.yd. Conneaut Twp., Erie Co., and 17,727 sq.yd. Ohio Twp., Beaver Co., to J. C. Devine Co., Meadville, $64,481 and $75,111 respectively. Grand total $378,557. Noted Aug. 7.

**Pa., Johnstown** — Improving Cosemaugh St. and Hillside Blvd., incl. 11,037 ft. 19 in. rein.-con. paving, 822 lin.ft. integral curb, 1,653 lin.ft. wire rope guard fence, 913 cu.yd. stone slope wall, 17,221 sq.ft. 4 in. concrete sidewalks, to Keystone Paving Co., State Theatre Bldg., Harrisburg. Noted Aug. 14.

**Pa., Phila.**—Dpt. P. Wks., Bureau of Hys., A. Murdock, dir., City Hall Annex, to Union Paving Co., Broad and Stiles Sts., asphalt paving (assessment work), Callowhill St. $6,493; Edmund St., $4,133; Michener St. $13,531; Ontario St. $3,656; Oxford St. (west shoulder) $5,404; Warden Dr. $26,713; 68th St. $12,514—to Montgomery Paving Co., Harrison Bldg., Cottage St. $2,445; Magee and Hellerman Sts. $5,774; Princeton St. $3,002—to Municipal Constr. Co., Washington Square Bldg., Ruffner St. $1,700—to M. Y. Neely, Inc., 9900 Bustleton Ave., improving Friendship and St. Vincent Rds. (country) $3,290—to Eastern Asphalt Co., Penna Bldg., redressed granite block repaving Poplar St. $25,777—to Atlas Paving Co., 317 South 6th St., repaving concrete railing on retaining wall, 13th and Huntingdon Sts. $843. Grand total $115,275. Noted Aug. 21.

**Pa., Phila.**—Dpt. P. Wks., Bureau of Hys., A. Murdock, dir., City Hall Annex, to Union Paving Co., Broad and Stiles Sts., asphalt paving (assessment work), Robbins St. $7,555; smooth dressed granite block repaving Allegheny and Erie Aves., Franklin, 16th and 18th Sts. $12,125; 6th, 13th, 15th, 17th, 18th, 22nd and 25th Sts. $19,373—to J. F. O'Rourke, 950 North 50th St., curb and footway work in 1st Hy. Dist. $1,963; 2nd Hy. Dist. $1,084; 3rd Hy. Dist. $784—to J. Derlin, Jr., Hancock and Thompson Sts., 5th Hy. Dist. $1,849; 6th Hy. Dist. $1,303. Grand total $46,036. Noted Aug. 28.

**R. I., Providence**—Bd. Contr. & Supply, sheet asphalt paving Dean St., to Lane Constr. Corp., 134 State St., Meriden, Conn. Est. $25,000.

**Tennessee**—State Dpt. Hys. & P. Wks., Nashville, grading, drainage structures, also bridge over 20 ft. span, 6.617 mi. road in Blount Co., to Jamison Bros., Inc., Cotton States Bldg., Nashville, $64,622—11.047 mi. Hamilton and Meigs Counties, incl. 4 bridges over 20 ft. span, to Johnson & Matthews, Rockwood, $95,682—5.296 mi. Sumner Co., to Chapman & Brown, Lafollette, $56,967. Grand total $217,271. Noted Aug. 14.

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Streets and Roads (Continued)

**Tennessee**—State Dpt. Hys. & P. Wks., Nashville, grading, drainage structures 6.057 mi. roads in Henderson Co., to McDade & McDade, Fulton, $44,553—6 mi. Montgomery Co., to Alexander & Hopson, Cadiz, $26,830—grading, drainage structures, 0.885 mi. Monroe Co., incl. bridge over 20 ft. span, to Ally Constr. Co., Bristol, $24,787—4.24 mi. Montgomery Co., incl. bridge over 20 ft. span, to M. T. McArthur, Johnson City, $78,938—2.75 mi. Sumner Co., also approaches to Woods Ferry Bridge, to R. E. Martion, Nashville, $28,082 — 1.606 mi. Troudsdale Co., incl. approaches to bridge at Harts Ferry, to K. V. Johnson, Edgefield, $21,187. Grand total $224,377. Noted Aug. 14.

**Tex., Houston**—H. L. Washburn, aud. Harris Co., asphaltic concrete on 6 in. concrete paving 50,825 sq.yd. Yale St., to Gulf Bitulithic Co., 2820 Polk Ave., $154,987. Noted Aug. 7.

**Utah**—State Hy. Road Comn., Salt Lake City, improving road from Monticello to Utah-Colorado state line, San Juan Co., to W. W. Clyde & Co., and J. W. Whiting, Springville, $50,017. Est. $55,959.

**Virginia**—State Hy. Comn., Richmond, clearing, grubbing, grading, one course macadam surfacing 9.998 mi. roads in Princess Anne and Norfolk Counties, to P. R. Ashby & Co., Raleigh, N. C., $178,092—1.058 mi. Augusta Co., to M. T. McArthur, Johnson City, Tenn., $32,567—clearing, grubbing, grading, concrete surfacing 3.4 mi. Elizabeth City Co., to Tunstall-Johnson Co., Inc., Norfolk, $51,461—2 mi. Warwick Co., to Virginia Eng. Co., Inc., Newport News, $44,949 — hauling and applying 100,000 gal. heated bituminous material on 6.8 mi. road in Pulaski Co., to S. E. Finley, 292 North Ave. N. W., Atlanta, Ga. $8,514—bridge over Rivianna River, Fluvanna Co., to M. S. Hudgins, Roanoke, $32,194. Grand total $347,777. Noted Aug. 14.

**West Virginia**—State Hy. Comn., Charleston, widening, paving roads in Raleigh and Fayette Counties, to Janitola & Co., and Gilbert Constr. Co., Glen Hedrick, $160,614 and $53,306 respectively — Jackson, Wirt, Kanawha and Wood Counties, to Lee & Johnson, Hampton, Ia., $41,340—Marshall Co., to W. L. Johnson Constr. Co., Hickville, O., $307,575—Monroe Co., to James Cain & Co., Elkins, $149,135 — Pocahontas Co., to Echols Bros., Alderson, $16,475—Roane Co., to Keeley Constr. Co., Clarksburg, $112,508—Wetzel Co., to Branham & Edwards, Clarksburg, $10,285—Wetzel Co., to C. H. Rice & Sons, Belmont, O., $19,733—Kanawha Co., to P. M. Burke, Charleston, $7,200. Grand total $878,071. Noted Aug. 15.

**Ont., Ottawa**—Ottawa Suburban Rds. Comn., widening, paving Richmond Rd. from Driveway, to Westboro, to Grand Bros. Contg. Co., Ltd., 354 Bank St., $50,000.

**Ont., Ottawa**—Asphalt paving Bank St. and Havelock Ave., to O'Learys Ltd., Rideau St. $20,869 and $3,198 respectively—Rideau St., to Standard Paving Co., Ottawa, $15,883—15,000 cu.yd. fill at filtration plant, Lemieux Island, to Kendall Bros., Ottawa, at $0.90 per cu.yd.

**Ont., Toronto**—City Council, asphalt paving Glengrove Ave., to Godson Contg. Co. Ltd., 203 Richmond St. W., $33,613—Hillside brick block paving Oakcrest Ave., to Grant Constr. Co. Ltd., 47 Wellington St. $5,549—concrete paving lane near Gerrard St., to Certified Cement Co., 6 Endean Ave. $1,091—2 lanes, to Weston Constr. Co., 132 Vaughan Rd. $4,256. Grand total $44,539.

**Ont., Toronto**—York Twp., asphalt on concrete paving 0.5 mi. Montcalm, Eglinton and Mould Aves., to R. C. Huffman Constr. Co. Ltd., 331 Bay St., $46,304. Est. $46,000.

**Ont., Windsor**—R. J. Desmarais, engr., City Hall, concrete paving 1 mi. Ottawa St., 50 ft., to Canada Paving Co., Sandwich St., East Windsor. Est. $65,000.

## EXCAVATION, DRAINAGE, IRRIGATION, LEVEES, RIVER AND HARBOR

### PROPOSED WORK

**Calif., Richmond**—Berkeley Waterfront Co., c/o R. A. Beebee, engr., 1 Montgomery St., San Francisco, filling in Richmond Inner Harbor and along Berkeley waterfront, incl. 100,000 cu.yd. dredging, creosoted piles, rock faced bulkhead, $400,000.

**Calif., Santa Barbara**—City Council rejected bids East Blvd. Seawall, $74,000 available. Will readvertise. Noted Aug. 14.

**Ill., Havana**—For 8 mi. open ditches, 72,000 cu.yd. excav., and 1 mi. tile ditches in Liverpool Drainage Dist., Fulton Co. $29,000. G. Ratclif, Liverpool, atty.

**Ill., Lawrenceville**—Surveys straightening 5 mi. Embaraas River. State appropriated $69,000 toward cost. R. Bensfield, Lawrenceville, and G. C. Harvey, Mt. Carmel, engrs.

**Mich., Detroit**—Detroit Yacht Harbor, 1010 Lafayette Bldg., yacht harbor inclosed by square wall, 900 ft. on each side of square, clubhouse, machine shop, concrete piers and boat wells, dredging, $500,000.

**Ont., Windsor**—Essex Border Utilities Comn., O. E. Fleming, K. C., chn., Equity Bldg., widening, deepening Grand Marais Creek, extending drain through townships, $2,000,000; disposal domestic waste, $170,000.

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### BIDS ASKED

**Ill., Mattoon**—Sept. 22, by Bd. Comrs. Union Drainage Dist. 1, towns of Mattoon and Whitley, at office Craig & Craig, attys., 11,050 cu.yd. excav. W. E. Millar, Mattoon, engr.

**Illinois**—Sept. 22, by Bd. Comrs. Union Drainage Dist. 1, Montgomery Co. (Boise) and Macoupin Co. (Girard), at Town Hall, Farmersville, 27,900 ft. ditch work, incl. 25,000 cu.yd. excav. J. W. Dappert & Sons, 332 Reisch Bldg., Springfield, consult. engrs.

**Ky., Morganfield**—Sept. 15, at office E. R. Morton, clearing 50 acres, cleaning out, straightening creek channel, 250,000 cu.yd. excav., Casey Creek Pub. Ditch Union Co. J. V. Poole, Corydon, engr.

**La., Opelousas** — Sept. 22, by Bd. Comrs. Prairie Basse Gravity D. D. 15, St. Landry Parish, 35 mi. drainage canals, 600,000 cu.yd. earth excav. M. J. Goudeau, Opelousas, engr.

**La., Shreveport** — Sept. 17, by Bd. Comrs. Caddo Levee Dist., Court House, improving 4.5 mi. Sect. 1, Big Willow Pass to Gilmore Ditch, 825,000 cu.yd. excav.; repairing bank protection, Red River, 2,810 lin.ft. Havana Bend, 200 lin.ft. Corner Place Bend, 350 lin.ft. Cairo Bend, 550 lin.ft. Cash Point Bend, building up, filling out, strengthening standards at Twelve Mile Bayou Bend and White Hall Bend, all in Caddo Parish.

**Mass., Milton** (br. Boston) — Sept. 18, by Metropolitan Dist. Comn., 1 Ashburton Pl., Boston, drainage in Blue Hills Parkway, incl. 2,500 cu.yd. trench excav., 30 cu.yd. concrete masonry, 1,020 lin.ft. 42 in. rein.-con. pipe, 360 lin.ft. rein.-con. pipe; 30 lin.ft. 42 in. riveted steel pipe. D. A. Ambrose, Metropolitan Dist. Comn., Boston, engr.

**Mass., Woburn**—See "Contracts Awarded."

**Pa., Pittsburgh**—See "Bridges."

**B. C., New Westminster** — Sept. 30, by N. Desjardins, secy. Dpt. P. Wks., Ottawa, Ont., raising level 1,200 ft. Fraser River Jetty, incl. 20,000 cu.yd. rock, for Dominion Govt. $40,000. C. C. Worsfold, P. O. Bldg., engr.

### CONTRACTS AWARDED

**Calif., Oroville**—C. F. Belding, clk. Butte Co., causeway fill in Road Dist. 1, to Lord & Bishop, Oroville, $29,873. Noted Aug. 28.

**Illinois** — Sangamon Outlet Dist., Mason, Menard and Cass Counties, excavating 688,000 cu.yd., to Gillen Constr. Co., Beardstown.

**Ill., Peoria**—See "Unclassified."

**Indiana**—Big Pipe Creek Drainage Dist., 34 mi. ditchwork in Grant, Wabash, Miami and Howard Counties, to General Dredging Co., Ft. Wayne.

**Ia., Red Oak**—Storm drains in 12 blocks, to Wilson Concrete Co., Red Oak, $25,544.

**La., New Orleans**—State Bd. Engineers, 207 New Orleans Court Bldg., Harvey Canal Bend bank protection work on Red River, 23,000 cu.yd. excav. in Dixie Gardens, to Adair & Hudson, Dixie, at $0.184 per cu.yd., 30,200 cu.yd. in Uni Levee, to E. L. McCane, Shreveport, $0.1925, 64,000 cu.yd., in Shreveport-Robeson Levee, to S. N. Yarborough, Shreveport, $0.2225, 45,300 cu.yd. Hollingsworth and 51,500 cu.yd. Chick Levees, to J. L. Granger, St. Joe, $0.1275, all Bossier Parish; 61,300 cu.yd. in Wild Lucio-Crescent Levee, to Robinson Constr. Co., Hosston, $0.184, 7 current retards or 7 permeable crib reflection spurs, 1,050 ft. long, both Caddo Parish, to H. N. Moody, New Orleans, $54,600. Noted Aug. 14.

**Mass., Woburn** — City and Middlesex Co. Comrs. (lessee), excavation for new city hall, police station and court house, Common St., day labor, $25,000. M. A. Dyer & Co., 1 Beacon St., Boston, archts.

**Pa., Roscoe**—H. C. Frick Coke Co., Carnegie Bldg., Pittsburgh, 700 cu.yd. concrete, 60,000 ft. timber, 25 tons structural steel for improving Colonial Docks on Monongahela River, opposite here, to Enterprise Contg. Co., Bessemer Bldg., Pittsburgh.

**Tenn., Memphis**—St. Louis & San Francisco R.R. Co., Frisco Bldg., St. Louis, Mo., F. G. Jonah, ch. engr., river bank protection, to Massman Constr. Co., 519 Amer. Bank Bldg., Kansas City, Mo., $150,000.

**Virginia**—Butts Roads Dist., Portsmouth, 30 mi. ditch work embracing 14,000 acres in Butts Road and Pleasant Grove Magisterial Dists., Norfolk Co. and Blackwater Dist., Princess Anne Co., to Wills Constr. Co., St. Louis, Mo.

**Canada**—N. Desjardins, secy. Dpt. P. Wks., Ottawa, Ont., constructing south jetty at New Westminster, to W. R. Jaynes Co., New Westminster, B. C., $353,145, north jetty, to Coats Quarries Ltd., Vancouver, B. C., $408,997, both in British Columbia; stone fill in western breakwater, Shippigan Gully, to J. L. Larkes, St. John, N. B., $10,560, constructing breakwater, Beresford, to E. & D. J. Connelly, Bathurst, N. B., $46,334, both in New Brunswick; improving shore protection, Champlain, to Nap. Trudel & Sons, Ste. Irenée, Que., $16,898, constructing protection wall, Laprairie, to A. Lacroix, St. Lambert, Que., $86,682, both Quebec; protection work at entrance of channel, Skinners Pond, Prince Edward Island, to A. Martin, Bloomfield, $31,780; dredging Musquodobit Harbour, to Halifax Dredging Co., Ltd., Ray Bldg., Halifax, N. S., $10,680, dredging, Metaghan, to Beacon Dredging Co., Ltd., Halifax, N. S., $20,375; breakwater, Ballantynes Cove, to G. W. Mason, Merigonish, N. S., $8,198, Lloyds Cove, to H. McNeil, Sydney Mines, N. S., $9,560, all Nova Scotia; dredging, Michipicaten, to A. B. McLean & Sons, Sault Ste. Marie, Ont., $130,050, reevtment wall, Saugeen River, to G. L. Campbell & Co., Midland, Ont., $18,439, reconstructing breakwater, Port Maitland, to W. K. Cameron, 39 Pine St., Welland, Ont., $29,820, Whitby, to R. Macdonald & Co., Ltd., 1130 Bay St., Toronto, $35,000, all Ontario. Grand total $1,216,518.

**B. C., Kelowna**—Black Mountain Irrigation Dist., earth fill dam, to J. E. Morton, Rutland, $40,010.

**Sask., Saskatoon** — See "Residential under Bids Asked."

## Public Bond Elections

### *Coming Bond Elections*

**Waterworks**—Torrence, Calif., $400,000.
**Water Dist. System** — Walnut Creek, Calif., $50,000.
**Waterworks**—Leoti, Kan., $35,000.
**Sewers**—Baton Rouge, La., October, $318,000.
**Bridge** — San Francisco, Calif., Golden Gate Bridge & Hwy. Dist., Nov. 4, $35,000,000.
**Irrigation** — Texas, Cameron County Water Impvt. Dist. 11, S. I. Jackson, Secy., Pt. Isabel, $585,812.
**Airport**—San Francisco, Calif., $4,000,000.
**Auditorium**—Fresno, Calif., $1,000,000.
**Jail**—San Francisco, Calif., $850,000.
**Fire Engine Houses, etc.**—Dayton, O., November, $400,000.

### *Bonds Voted*

**Water Supply** — Holdenville, Okla., $225,000. C. H. Edge, Engr.
**Sewage Disposal Plant**—Sulphur, Okla., $30,000.

### *Bonds Defeated*

**Waterworks**—Hobart, Okla., $400,000.
**Schools**—Berkeley, Calif., $2,690,000.

## FEDERAL GOVERNMENT

### PROPOSED WORK

**N. J., Wanaque**—POST OFFICE—Treas. Dpt. at office Sup. Archt., 2 story, basement, brick, steel, Ringwood Ave. and Erie St. J. A. Wetmore, acting superv. archt.

**Tex., Plainview**—POST OFFICE—Treas. Dpt. at office Sup. Archt., post office.

**Tex., Wichita Falls**—POST OFFICE—Treas. Dpt. at office Sup. Archt., Wash., D. C., post office.

**Va., Norfolk**—POST OFFICE—Treas. Dpt. at office Sup. Archt., Wash., D. C., post office.

### BIDS ASKED

**Arkansas, Missouri and Mississippi**—LEVEE—Sept. 16, by U. S. Eng. Memphis, Tenn., 684,200 cu.yd. levee work in Lower St. Francis and Upper St. Francis Levee Dists., White River and Upper Yazoo Dists.

**D. C., Wash.**—PUMPS—Sept. 19, by A. L. Flint, genl. purch. officer Panama Canal, pumps wrenches, wood stools, bolts, nuts, rivets washers, Schedule 2587.

**Md., Baltimore**—DREDGING—Oct. 7, by U. S. Eng., 300 Custom House, dredging 1,113,232 cu.yd. in entrance to and through Craighill Section and Craighill Cutoff angle, and 192,635 cu.yd. in Ferry Bar Sect. channels leading to here; adv. E. N.-R. Sept. 11. Noted Sept. 4.

**Miss., Gulfport**—SEWAGE DISPOSAL PLANT—Sept. 30, by U. S. Vet. Bur., Arlington Bldg., sewage disposal plant, incl. grading, mains, pumps, sand filters and chlorinators, at U. S. Veterans' Hospital.

**New Jersey**—DREDGING—Sept. 23, by U. S. Eng., Wilmington, Del., 8,350 cu.yd. from Mantua Creek; adv. E. N.-R. Sept. 11.

**N. J., Picatinny Arsenal** (mail Dover)—POWDER BUILDINGS—Sept. 29, at office Con. Q.M., 2 buildings for blending powder, 2 tunnels, lightning protection system in Smokeless Powder Manufacturing Area; adv. E. N.-R. Sept. 11.

**N. Y., Buffalo**—RETAINING WALL—Oct. 3, by U. S. Eng. replacing 298 lin.ft. steel sheet pile retaining wall at upstream approach to Black Rock Lock, with rein.-con. wall on pile supported platform; adv. E. N.-R. Sept. 11.

**O., Fairport**—BREAKWATER—Sept. 16, by U. S. Eng., Buffalo, N. Y., 4,000 lin.ft. stone rubble mound breakwater extension of existing east breakwater at Fairport Harbor. Noted Sept. 4.

**Pa., Carlisle Barracks**—MESS HALL—Oct. 1, at office Con. Q.M., mess hall; adv. E. N.-R. Sept. 11.

**Tenn., Memphis**—GRADER DERRICKBOAT—Oct. 7, by U. S. Eng., constructing, delivering afloat 1 steel hull grader derrickboat; adv. E. N.-R. Sept. 11. Noted Sept. 4.

**Tenn., Memphis**—PILE DRIVER—Oct. 7, by U. S. Eng., constructing, delivering afloat 2 steel hull pile drivers; adv. E. N.-R. Sept. 11. Noted Sept. 4.

**Texas**—DREDGING—Sept. 24, by U. S. Eng. Office, Galveston, 119,000 cu.yd. Dickinson Bayou Channel. Noted Aug. 14.

### CONTRACTS AWARDED

**Arizona**—ROAD—Bur. P. Rds., Sheldon Bldg., San Francisco, Calif., surfacing 17.57 mi. Grand Canyon Old Trails National Park Hy., Tusayan Natl. Forest, Coconino Co., to J. C. Morse, 1209 Hoffman Ave., Long Beach, Calif., $32,216. Noted Aug. 7.

Federal Government (Continued)

**Calif., Riverside** — HOSPITAL — Con. Q.M., March Field, hospital, to R. L. Chute Co., 2506 West Santa Barbara St., Los Angeles, $115,892; 12 quarters, to Cresmer Mfg. Co., Riverside, $71,830. This corrects report in Sept. 4 issue.

**Colorado**—ROAD—A. E. Palen, dist. engr. Pub. Rds., Denver, grading 6.02 mi. Willow Creek Pass National Forest Rd., Grand Co., to Pioneer Constr. Co., Denham Bldg., Denver, $67,111. Noted Aug. 7.

**Ga. Fort Benning**—Quarters—Con. Q.M., 8 company and 60 non-commissioned officers quarters, to Murphy-Pound, Columbus, Ga., $449,045. Noted July 24.

**Mo., Sedalia**—POST OFFICE—Treas. Dpt. at office Sup. Archt., post office, Kellogg & Anderson, Taylor, Tex., $114,855. Noted Aug. 7.

**New York**—DREDGING—U. S. Eng., Army Bldg., Whitehall St., New York, 62,900 cu.yd. soft material and removing 200,000 cu.yd. ledge rock, in Hudson River at Mulls, 11 mi. south of Albany, to Great Lakes Dredge & Dock Co., 17 Battery Pl., New York, at $1.479 per cu.yd., total $389,717. Noted July 31.

**N. Y., Iona Island** — SUB-SURFACE MAGAZINES, etc. — Yards & Docks, sub-surface magazines and railroad at Naval Ammunition Depot, to Hercules Constr. Co., 41 East 40th St., New York, $34,490.

**Pa., Phila.**—DREDGING—Yards & Docks, dredging at Phila. Navy Yard and Naval Ammunition Depot, Fort Mifflin, to Amer. Dredging Co., Mar. & Mer. Bldg., $124,000.

**Va., Langley Field**—QUARTERS—Con. Q.M., 13 double houses, officers quarters, to Jones Constr. Co., Charlotte, N. C., $170,000. Noted Aug. 7.

**Va., Quantico** — WELLS — Yards & Docks, wells at Marine Barracks, to Layne Atlantic Co., Norfolk, $36,082.

**Wash., Blaine** — CUSTOM HOUSE — Treas. Dpt. at office Sup. Archt., custom house and immigration inspection station, to Johnson Bros., 1716 East 56th St., Seattle, $126,000. Noted Sept. 4.

**T. H., Pearl Harbor** — BORINGS — Yards & Docks, wash borings at Naval Operating Base, to A. H. Hobart, Honolulu, $11,140.

## RAILWAYS

### PROPOSED WORK

**Illinois**—Chicago Rapid Transit Co., 72 West Adams St., Chicago, plans expending $6,872,000, material and labor expanding platforms for 8 car train operation, changes in yard terminals for 8 car train operation, changes in track and interlocking at Marshfield Ave., adding third track and remodeling platform at Chicago Ave., changing brake valves and installing additional switches and new resistances, replacing full swinging gates with collapsible gates on certain cars, new shop unit at Niles Center, additional track, Garfield park branch, Laramie to Marshfield Aves., incl. realignment through Sacramento Station, new merchandise mart station, Kinzie St., reconstructing station entrances ,booths, etc., to provide for transformers between elevated and surface lines, engineering expenses.

**Texas**—Texas & Pacific Northern Ry. Co., c/o Texas & Pacific Ry., E. F. Mitchell, Dallas, ch. engr., 333 mi. extension to Texas & Pacific lines between Big Springs and Amarillo, with branch lines to Lubbock and Vega, $13,000,000.

### CONTRACTS AWARDED

**Mississippi**—Goodyear Yellow Pine Co., J. R. Clark, Jr., ch. engr., Picayune clearing right-of-way, grading 8 mi. railroad, in Picayune, to C. H. Williams, Picayune. Total est. incl. steel, etc. $80,000.

**Oregon and California**—Great Northern Ry. Co., J. R. W. Davis, ch. engr., Railroad Bldg., St. Paul, Minn., 88 mi. track extension from Klamath Falls, Ore., to Bieber, Calif., to A. Guthrie & Co., 1209 Builders Exch., St. Paul, Minn. Noted July 3.

**Pennsylvania**—See "Bridges under Connellsville."

**Pennsylvania**—Monesson South Western R.R. Co., subsidiary of Pittsburgh Steel Co., grading, masonry for 2.5 mi. line connecting with Pittsburgh & West Virginia Cochran Mills, to Vang Constr. Co., Grant Bldg., Pittsburgh, $175,000. Est. $200,000. Noted July 31.

**Pennsylvania**—Pittsburgh & Lake Erie R.R. Co., A. R. Reymer, ch. engr., Terminal Bldg., Pittsburgh, 3 mi. single track between Monaca and Bellowsville, to Ferguson & Edmundson, Keystone Bldg., Pittsburgh, $500,000. Noted Aug. 14.

**Pennsylvania**—Pittsburgh & Wheeling Div. of Baltimore & Ohio R.R., H. A. Lane, ch. engr., Baltimore, Md., grading west of Rand, to T. J. Foley Co., 160 South Euclid Ave., Bellevue, $20,000.

**Ontario** — Temiskaming & Northern Ontario Ry., S. B. Clement, ch. engr., North Bay, 40 mi. railway between terminus at Blacksmith Rapids on Abitibi River and Moose Factory on James Bay, to H. F. McLean Ltd., Reford Bldg., Toronto. Est. $2,000,000.

**Ontario** — See "Factories and Mills, under Toronto."

## SUBWAYS AND TUNNELS

### PROPOSED WORK

**Ont., East Windsor**—C. V. Waters, town clk., soon takes bids general contract, structural steel, mechanical and electrical equipment for steel, concrete subway under railroad tracks at Wyandotte St. and Drouillard Rd., for Town and Canadian National Ry. T. T. Irving, ch. engr., Toronto. $100,000. H. C. McMordie, King Bldg., Windsor, engr.

### BIDS ASKED

**N. Y., Brooklyn**—Sept. 26, Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., New York, constructing Sect. 8, Route 107, along and under Lafayette Ave. from South Oxford St. to Bedford Ave.

**N. Y., New York**—Sept. 19, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., installing tracks, other work for part 14th St.-Eastern Rapid Transit R.R., Route 8, Sect. 1-A, along and under 14th St. from 6th to 8th Aves.

**N. Y., New York**—Sept. 19, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., altering railroad structure to permit widening roadway of Mott Ave. from East 138th to East 151st Sts., Agreement "10."

### CONTRACTS AWARDED

**Calif., Sacramento**—City and Southern Pacific R.R. Co., 65 Market St., San Francisco, G. W. Boschke, ch. engr., H Street Subway, on concrete pile found., $98,470.

**Man., Winnipeg**—Canadian National Ry., A. E. Warren, genl. mgr. western region, 10 track subway, steel, rein.-con., under Canadian National Ry. tracks, on Pembina Hy., to Foley Bros. Ltd., Winnipeg, $500,000.

## GRADE CROSSINGS

### PROPOSED WORK

**New York**—Pennsylvania R.R. Co., T. J. Skillman, ch. engr., Broad Street Sta., Phila., Pa., eliminating Hitcorb, Shreve and Osborne Crossings, in Clymer and Sherman, Chautauqua Co. $31,400.

**N. Y., Avoca** — Delaware, Lackawanna & Western R.R. Co., G. J. Ray, ch. engr., Hoboken, N. J., eliminating grade crossing 2 mi. west of Kanona Station, Bath-Avoca State Hy., Steuben Co. $132,000.

**N. Y., Genesee Falls**—Pennsylvania R.R. Co., T. J. Skillman, ch. engr., Broad Street Sta., Phila., Pa., eliminating Castile Road Crossing, Wyoming Co. $127,150.

**N. Y., Utica**—New York—Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, eliminating Utica Frankfort state highway crossing, 3.8 mi. east of Utica Station and the Stop 2 Crossing, 5.1 mi. east of South Utica Station, in Frankfort, Herkimer Co. $151,700.

**N. Y., Whitehall**—Delaware & Hudson R.R. Co., J. MacMartin, ch. engr., Albany, eliminating grade crossings at Boardman, Main, Church and Bellamy Sts. $851,900.

**N. Y., York**—Genesee & Wyoming R.R., M. B. Fuller, pres., Scranton, Pa., reconstructing existing structure carrying Pavilion-Greigsville Hy. over tracks. $58,000.

**Utah**—State Rd. Comn., Capitol Bldg., Salt Lake City, concrete overpass at Ford Creek. $40,000. H. S. Kerr, state engr.

### BIDS ASKED

**N. Y., White Plains**—Sept. 22, at office Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, stone faced rein.-con. undercrossing at Hall Ave. J. Downer, ch. engr.; adv. E. N.-R. Sept. 11.

### CONTRACTS AWARDED

**N. Y., Champlain**—Delaware & Hudson R.R., J. MacMartin, ch. engr., Albany, eliminating grade crossing Copperville Station, on Chazy-Rouses Point State Hy., to Peckham Constr. Co., Crosby Bldg., Buffalo, $37,944.

**N. Y., Crown Point** — Delaware & Hudson R.R. Co., J. MacMartin, ch. engr., Albany, eliminating Curriers Crossing on Curriers Corners-Fort Amherst Co. Hy., south of Port Henry station, Essex Co., to Peckham Constr. Co., Crosby Bldg., Buffalo, $95,517.

**N. Y., Queensbury**—Delaware & Hudson R.R. Co., J. MacMartin, ch. engr., Albany, eliminating Warren St. Crossing on Sandy Hill-Glens Falls Co. Hy., Warren Co., to Scott Bros. Constr. Co., 235 West Dominnic St., Rome, $70,879.

**Ohio**—R. N. Waid, dir. hys., Columbus, grade crossing elimination, incl. grading, traffic bound macadam paving Noble Co., to N. M. Lupo, Cleveland Heights, $47,404. Cancelled bids Aug. 26, constructing grade crossing elimination, Butler Co., est. $93,369. Noted Aug. 21.

## DAMS

### CONTRACTS AWARDED

**B. C., Kelowna**—See "Excavation, Drainage, Irrigation, Levee, River & Harbor."

## PIERS AND WHARVES

### PROPOSED WORK

**Calif., Oakland**—WHARF—Western Pacific R.R. Co., Mills Bldg., J. W. Williams, ch. engr., filling concrete bulkhead, 750 ft. wide, 435 ft. long, with wharf 418 ft. long, 75 ft. wide, Adelina St.

**Mass., Barnstable**—PIER—H. C. Loyd, timber, pier bulkhead, solid fill, Poppenesett Bay, $25,000. Private plans.

**Pa., Kittanning**—PIERS—See "Bridges."

**Ont., Cobourg**—PIER—Town Council, reconstructing pier, steel sheet piling, concrete precast block, $44,953. Russell Constr. Co., Harbor Comn. Bldg., Toronto, engrs.

### CONTRACTS AWARDED

**Canada**—WHARVES—N. Desjardins, secy. Dpt. P. Wks., Ottawa, Ont., reconstructing wharves in Pierreville, to J. E. Fleury, Three Rivers, Que., $19,160, Riviere Blanche, and extending wharf in Ste. Felicite, to L. Lemieux, Ste. Marie de Beauce, Que., $14,296 and $22,935 respectively, Tourelle and St. Charles de Caplain, to A. & C. Nadeau, Chandler, Que., $20,422 and $9,000 respectively, Ste. Anne de la Pocatiere, to J. D. Anjou, Lac St. Pierome, Que., $20,376, Ste. Anne des Monts, to J. Journer, Costereal, Que., $28,015, all foregoing in Quebec; constructing wharves in Sombria, to C. Reid Ltd., Bank of Montreal Bldg., Windsor, Ont., $21,376, Sarnia, to Detroit River Constr. Co., Security Bldg., Windsor, Ont., $75,946, repairing pier at Leamington, to Chatham Dredging Co., 18 Llewellyn St., Chatham, Ont. $16,188, all foregoing in Ontario; extending wharf in Hecla, Manitoba, to G. B. Wood, Ltd., 194 Sutherland Ave., Winnipeg, Man., $21,940. Grand total $269,654.

## AIRPORTS

### BIDS ASKED

**Calif., Alameda**—Alameda Bay Airdome, Webster St., taking bids 120 x 440 ft. steel hangar, administration building. $100,000. Private plans.

**O., Akron**—See "Streets and Roads."

**O., Akron**—Sept. 20, by Bd. Control, general contract 2 story, brick administration building at Municipal airport, $175,000. M. M. Konarski, Merriman Rd., archt.

### CONTRACTS AWARDED

**Wyo., Rock Springs**—Boeing Air Transport Co., c/o H. A. Humphries, vice pres., Cheyenne, 80 x 130 ft. hangar and administration building, to Austin Constr. Co., 16112 Euclid Ave., Cleveland, O., $40,000. Noted Aug. 14.

## GRAIN ELEVATORS

### CONTRACTS AWARDED

**Ill., Chicago** — GRAIN ELEVATOR — Chesapeake & Ohio R.R. Co., Richmond, W. Va., C. W. Johns, ch. engr., masonry contract 49 x 364 ft. brick storage, 103rd St. and Calumet River, to P. A. Eusine, 332 South La Salle St.; carpentry contract to M. A. Long Co., 332 South La Salle St. Est. $150,000.

## POWER AND LIGHTING

### PROPOSED WORK

**Calif., Oakland**—Ornamental lighting system, incl. underground system in East 12th St. between Lake Shore Dr. and 13th Ave. $25,000 or more. W. N. Frickstad, City Hall, engr.

**N. J., Plainfield**—Common Council, City Hall, 7 traffic lighting units, $25,000. A. Vars, city engr.

**Pa., Pittsburgh** — City and Duquesne Light Co., 435 6th Ave., removing old trolley lighting poles, on 5th Ave. between 6th and Liberty Sts., placing underground street lighting wires, installing 73 artistically designed, aluminum painted fluted posts on ornamental cast steel bases, each post supporting 2 especially designed lamp brackets. $80,000. City pays $36,000 and balance by Duquesne Light Co.

### CONTRACTS AWARDED

**Calif., San Diego**—See "Streets and Roads."

**N. Y., New York**—M. Cosgrove, comr. Docks, Pier "A," Battery Pl., North River, electric wiring for sheds for Pier New 3, North River, to L. A. Feldman, 1015 East 31st St., Brooklyn, $46,380. Noted Aug. 21.

## SPORTS AND PARKS

### PROPOSED WORK

**Mich., Detroit**—See "Excavation, Drainage, Irrigation, Levees, River and Harbor."

**N. Y., Brooklyn**—City, c/o Superintendent P. Offices & Buildings, Municipal Bldg., bids late in November, altering 2 story bath houses, $100,000.

**Pa., Haverford**—Haverford Twp., School Bd., G. C. Young, chn. property comn., plans by Boyd, Abel & Gugart, Otis Bldg., Phila., stadium. $175,000.

### BIDS ASKED

**N. J., Nutley**—M. A. Wolf, archt., 845 Broad St., Newark, bids about Sept. 15, general contract 1 story, brick, frame amusement park, incl. 2 swimming pools, stores, bathhouses, etc., for Harrison Park Impvt. Co., 24 Branford Pl., Newark. Est. $150,000. Noted Aug. 7.

## HEATING AND VENTILATING

### BIDS ASKED

**Calif., San Francisco**—Oct. 17, by Bd. Regents University of California, at Berkeley, mechanical equipment for central heating plant on campus.

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Heating and Ventilating (Continued)

**CONTRACTS AWARDED**

**Mass., Westfield**—City, heating in Boy's Trade School, Bartlett St., to M. F. Gardner, 2 Morse Ave., $19,500; plumbing, to E. W. Michalek, 55 Hanover St., West Springfield, $5,798; electrical work, to Richardson Electric Co., 22 Main St., Westfield, $6,501. Grand total $31,799. Noted Sept. 4, under "Schools — Contracts Awarded."

**N. Y., Marcy**—Dpt. Mental Hygiene, State Office Bldg., Albany, heating at Marcy Div., Utica State Hospital, to H. K. Brandeles, 1602 Lincoln Ave., Utica, $51,847. Noted July 17.

**N. Y., New York** — Bd. Higher Educ., at office secretary Hunter College, Park Ave. and 68th St., heating for Unit 2, Hunter College, to W. G. Cornell & Co., 258 5th Ave., $78,867; plumbing, to H. Homer & Son, 11 West 42nd St., $35,790; electrical work, to Lord Electric Co., 105 West 40th St., $28,700. Grand total $143,367. Noted Aug. 7.

## UNCLASSIFIED

**PROPOSED WORK**

**Ariz., McNary** — FISH HATCHERY — State Fish & Game Dpt., Phoenix, preliminary plans 40 x 70 ft. rearing ponds, $10,000; trout hatchery with hatching and feeding ponds, $12,000. Lesher & Mahoney, Phoenix, archts.

**Calif., Long Beach**—MAUSOLEUM—T. W. Bishop, F. C. Huber & M. F. Jones, 622 Chapman Bldg., plans by N. P. Rummonds, 116 Locust Ave., 96 ft. tower, 216 x 430 ft., 135,000 sq.ft. floor space, chapel seating 250 people, rein.-con., marble, tile, glass, bronze, Redondo Blvd. To exceed $500,000.

**Tex., Pettus**—TANK FARM—Humble Oil & Pipe Line Co., Humble Bldg., Houston, and Ingleside, steel tank farm, near here. Private plans.

**BIDS ASKED**

**Mass., Malden** (br. Boston)—COMFORT STATION—Sept. 15, by City, F. J. Walsh, City Hall, and C. F. Springall, archt., 50 Park St., 1 story, brick, steel, concrete, Huntings Field, $25,000. Noted July 24.

**Mass., Boston**—EXCAVATION and CAISSONS—H. K. Ferguson Co. (contractors), 260 Tremont St., taking bids excavation and caissons for Professional Arts Building, Trinity Pl., Dartmouth and Stuart Sts., for Park Sq. Real Estate Trust, W. J. McDonald, 260 Tremont St. Noted Aug.,7 under "Offices, Contracts Awarded."

**N. Y., Yonkers**—COMFORT STATION—Sept. 24, by Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, comfort station, incl. electrical work, at Tibbetts Brook Park, J. Downer, Bronxville, ch. engr.; adv. E. N.-R. Sept. 11.

**CONTRACTS AWARDED**

**Ill., Peoria**—RIVER and RAIL TERMINALS—W. E. Moran, city clk., dock house, to R. Iben, Peoria Life Bldg., $112,185; bulk terminal and track, to Congress Constr. Co., 506 South Wabash Ave., Chicago, $117,070. Noted July 31.

**N. Y., Port Richmond**—TANKS—Gulf Refining Co., Frick Bldg., Pittsburgh, Pa., 3 steel tanks, Lamberts Lane and Bloomfield Rd., to McClintic Marshall Co., 39 Bway., New York, Est. exceeds $45,000.

**N. Y., Rochester** — CORRIDORS — Commissioner Dpt. Mental Hygiene, State Office Bldg., Albany, connecting corridors, metal partitions for Buildings 1, 2 and 3, Rochester State Hospital, to Gorsline & Swan Constr. Co., 243 Powers Bldg., $81,500. Noted July 24.

**N. Y., Syracuse** — WALL — Onondaga Co., Court House, concrete wall around penetentiary at Jamesville, to Mondo Constr. Co., South Townsend St., $38,761.

**N. Y., Willard**—EXIT FACILITIES—Commissioner Dpt. Mental Hygiene, State Office Bldg., exit facilities, fire stops at Willard State Hospital, to C. M. McLean, 332 Water St., Binghamton, $31,800.

**Texas**—PIPE LINE—Humble Oil Co., Humble Bldg., Houston, and Port Arthur, 38 mi. 6 and 4 in. c.i. pipe (screw points) line from point near Refugio to Pettus, to J. D. Hughes, Beeville and Refugio, $110,000; constructing oil pipe line pumping station for above pipe line, near Pettus, owner builds, $30,000.

## MATERIALS

**BIDS ASKED**

**PIPE, etc. — Oakland, Calif.** — See "Waterworks."

**CABLES—Pasadena, Calif.**—Sept. 18, by B. Chamberlain, city clk., miscellaneous quantity lead covered cables for Muny Light and Power Dpt.

**CONDUIT, etc.—Detroit, Mich.**—Sept. 13, by J. E. Mills, comr. Purchases & Supplies, 10 carloads 3 in. conduit with ¼ in. wall, socket joint, 8 carloads 4 in. with ¼ in. wall, Harrington joint, 3,000 four in. fibre couplings, f.o.b.

**GASOLINE — Clayton, Mo. — Sept. 17**, by Comrs. St. Louis Co., W. E. Miller, clk., gasoline during year ending Aug. 1931.

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**CONTRACTS AWARDED**

**CEMENT—Arkansas**—State Hy. Comn., Little Rock, 100,000 bbl. cement, to Okay Cement Co., Okay, prices vary from $2.42 to $2.18 per bbl. depending upon location of storage depots, add $0.25 per bbl. for paper sacks, add $0.50 per bbl. for cloth bags, refund $0.10 each for cloth bags returned, $0.10 per state discount, $0.10 per bbl. cash discount.

**OILS, GREASES, etc.—Mississippi**—State Hy. Dpt., Jackson, gasoline, oils, greases for entire state, to Pan-American Petroleum Co., 122 East 42nd St., New York. Est. $100,000.

**GRAVEL, etc.—Mississippi**—State Hy. Comn., Jackson, Fourth Main Entrance Div., hauling 8,000 cu.yd. washed, 11,000 cu.yd. sand clay, 3,000 cu.yd. clay gravel, 60,000 units overhaul, to M. Harvey, Oxford, $12,910; Seventh Maintenance Div., 22,000 cu.yd. washed, 34,000 cu.yd. sand clay, 12,000 cu.yd. clay gravel, 102,000 units overhaul and Eight Maintenance Div., 7,500 cu.yd. washed, 12,500 cu.yd. sand clay, 5,000 cu.yd. clay gravel, 37,000 units overhaul, to W. C. Denman, McComb, $26,180 and $9,750 respectively; Sixth Maintenance Div., 29,000 cu.yd. washed, 43,500 cu.yd. sand clay, 14,500 cu.yd. clay gravel, 222,500 units overhaul, and Fifth Maintenance Div., 11,000 cu.yd. washed, 16,500 cu.yd. sand clay, 5,500 cu.yd. clay gravel, 33,000 units overhaul, to Richton Investment Co., Inc., Richton, $50,090 and $13,860 respectively; First Maintenance Div., 9,000 cu.yd. washed, 13,500 cu.yd. sand clay, 4,500 cu.yd. clay gravel, 81,000 units overhaul, to Burks & Moneyhum, Saltillo, $15,660; Second Maintenance Div., 5,600 cu.yd. washed, 8,000 cu.yd. sand clay, 2,500 cu.yd. clay gravel, 48,000 units overhaul, to O. C. Thomas, Amory, $11,830; Third Maintenance Div., 8,000 cu.yd. washed, 11,000 cu.yd. sand clay, 3,000 cu.yd. clay gravel, 16,000 units overhaul, to Clark & McCaa, Jackson and Port Gibson, $9,620; drainage ditches on Federal Aid Project 65, west side Work Order Dist. 101, clearing, grubbing, 12,000 cu.yd. borrow, Yazoo Co., to Garrigeus Bros. Dredging Co., Tchula, $3,660; 2 cars grader blades f.o.b. Jackson, to Southern Plough Co., Columbus, $9,031. Grand total $162,591.

## EQUIPMENT

**BIDS ASKED**

**AIR COMPRESSOR — Iowa — Sept. 16**, by State Hy. Comn., Ames, two 90 cu.ft. air compressors, accessories.

**GENERATING UNITS and SWITCHBOARD—Morgan City, La.**—Sept. 16, by Bd. City Council, furnishing, installing two 400 kw. oil engine generating units, complete with accessories, also switchboard. Swanson & McGraw, Balter Bldg., New Orleans, engrs.

**TRUCK—Moorhead, Minn.**—Oct. 7, by A. O. Houglum, aud., one 4 wheel drive truck.

**PUMP—Pauls Valley, Okla.**—City in market 1,500 g.p.m. engine driven standby fire pump for Waterworks Dpt. J. S. Bottoms, city clk.

**GAS ROLLERS—San Antonio, Tex.**—Sept. 15, by Bexar Co., c/o W. S. Kendall, aud., one new 12 ton gas roller, 1 second hand gas roller, 1 old roller to be taken in exchange.

## FOREIGN

**Mexico, Matamoras**—Matamoras Bull Ring & Pleasure Resort Syndicate taking bids 4 story, basement, brick, tile, stucco, hotel, 40,000 sq.ft. floor space, $250,000; also large steel bull ring, $250,000.

**Mexico, Reynosa** — City, J. Tarega, mayor, waterworks improvement, incl. filtration plant, $100,000. Engineer selected soon.

# Buildings

## RESIDENTIAL

**BIDS ASKED**

**Calif., Berkeley**—See "Contracts Awarded."

**Calif., Oakland**—See "Contracts Awarded."

**Calif., San Francisco** — See "Contracts Awarded."

**N. Y., Bayside**—See "Contracts Awarded."

**N. Y., Brooklyn**—Realty Associates, F. Fox, pres., 162 Remsen St., bids in fall, general and separate contracts 17 story, 100 x 115 ft., Prospect Park West and 1st St., $1,400,000. E. Roth, 1440 Remsen St., archt.

**N. Y., Brooklyn**—See "Contracts Awarded."

**N. Y., Flushing**—See "Contracts Awarded."

**N. Y., Forest Hills**—See "Contracts Awarded."

**N. Y., Jamaica**—See "Contracts Awarded."

**N. Y., Maspeth**—See "Contracts Awarded."

**N. Y., New York**—See "Contracts Awarded."

**N. Y., New York**—H. I. Feldman, archt., 15 West 44th St., taking bids separate contracts, 95 Christopher St. and 330 Bleecker St., for Village Developers, Inc., 545 5th Ave. $1,000,000.

**N. Y., Richmond Hill** — See "Contracts Awarded."

**N. Y., Woodhaven**—See "Contracts Awarded."

**O., Cleveland**—R. J. Emerick, atty., Guarantee Title Bldg., taking new bids 5 story, basement, brick, steel, Edgewater Dr., $200,000. H. W. Greime & Sons, Leader Bldg., archts. Noted Apr. 3.

**O., Cleveland Heights**—B. D. Roseman, 1929 Taylor Rd., Cleveland, taking bids 3 story, basement, brick, Taylor Rd., $150,000. A. Sogg, B. F. Keith Bldg., Cleveland, archt.

**Wash., Seattle**—Realty Owners Corp., Northern Life Tower, bids about Oct. 26, 21 story, basement, 108 x 120 ft., rein.-con., steel, green and white cast stone hotel, 7th and Bell Sts. $1,500,000. T. Haire, Northern Life Tower, archt.

**Sask., Saskatoon**—Sept. 15, by J. Schofield, ch. archt. Canadian Natl. Rys., 514 Keefer Bldg., Montreal, Que., superstructure for hotel, 21st St. and Spadina Crescent, $2,000,000. Excavation, substructure, awarded to H. J. McDiarmid Co. Ltd., 210 Nokomis Bldg., Winnipeg, Man.

**CONTRACTS AWARDED**

**Calif., Berkeley**—Davis-Pearce Co., Builders Bldg., Stockton, 3 story, brick apartment, Sacramento Ave. and University Way, segregated contracts, $200,000.

**Calif., Los Angeles**—R. E. Fennell, c/o J. F. Cavanaugh, 816 Architects Bldg., 7 story, basement, 60 x 122 ft., wrought iron, rein.-con., incl. garage in basement, 714 Mariposa Ave., to Mishelle Constr. Co., Architects Bldg., $225,000.

**Calif., Oakland**—T. D. Fisher, 2851 23rd Ave., 8 story, steel, brick, Walker Ave., day labor and segregated contracts, $150,000.

**Calif., San Francisco** — F. L. Hansen, 282 7th St., 6 story, basement, rein.-con., steel, Green St. near Octavia St., day labor, $175,000.

**N. Y., Bayside**—Foster Madden Corp., 1 East 44th St., New York, 6 story, 181 x 190 ft., 43rd Ave. and Laurel Hill Rd., separate contracts, $750,000. Private plans.

**N. Y., Brooklyn**—B. and H. Building Corp., S. Borden, pres., 6 story, 126 x 140 ft. Ocean Ave. and Avenue R, separate contracts, $400,000. M. A. Cantor, 124 Livingston St., archt.

**N. Y., Brooklyn**—A. and A. Constr. Co., A. Glickman, pres., 6 story, 85 x 200 ft., 95th St. and Marine Ave., day labor and separate contracts, $400,000. B. W. Dorfman, 66 Court St., archt.

**N. Y., Brooklyn**—W. M. Calder Co., 2703 Avenue U, 2 story, Albany and Foster Aves., separate contracts, $150,000. J. A. Boyle, 367 Fulton St., archt.

**N. Y., Brooklyn**—Em King Realty Co., M. Kalt, pres., 26 Court St., 6 story, 84 x 96 ft., East 18th St. and Avenue M, separate contracts, $100,000. M. N. Weinstein, 93 Court St., archt.

**N. Y., Brooklyn**—Emen Building Corp., M. Rothchild, treas., 766 Montgomery St., 6 story, 98 x 130 ft., Empire Blvd. and Albany Ave., separate contracts, $200,000. Cohn Bros., 361 Stone Ave., archts.

**N. Y., Brooklyn**—Empire Nostrand Co., 191 Joralemon St., 6 story, 84 x 100 ft., Empire Blvd. and Nostrand Ave., separate contracts, $180,000. B. W. Dorfman, 66 Court St., archt.

**N. Y., Brooklyn**—Five Hundred Thirty-Five Parkside Avenue Corp., A. Goldberg, pres., 16 Court St., 6 story, 109 x 200 ft., Parkside and Bedford Aves., separate contracts, $340,000. Cohn Bros., 361 Stone Ave., archt.

**N. Y., Brooklyn** — Four Thousand Nine Hundred One 14th Avenue Corp., T. Trynin, pres., 10 Ocean Parkway, 6 story, 90 x 100 ft., brick, timber, steel, 49th St. and 14th Ave., separate contracts, $225,000. J. M. Ricca, 186 Remsen St., archts.

**N. Y., Brooklyn**—A. Heller Constr. Co., 1152 East 24th St., 6 story, 84 x 137 ft., East 18th St. and Beverly Rd., day labor and separate contracts, $250,000. W. T. McCarthy, 147 Pierrepont St., archts.

**N. Y., Brooklyn**—Kingslawn Holding Corp., W. Cordes, pres., 2176 Nostrand Ave., 2 story, East 42nd St. and Clarendon Rd., separate contracts, $400,000. R. T. Schaefer, 1543 Flatbush Ave., archts.

**N. Y., Brooklyn**—Martill Realty Co., S. Polstein, pres., 1436 55th St., 2 story, Battery Ave. and Ft. Hill Pl., separate contracts, $150,000. Cohn Bros., 361 Stone Ave., archt.

**N. Y., Brooklyn** — Maybeck Realty Co., J. Sommers, pres., 65 Court St., 6 story, Mayo St. and Ocean View, separate contracts, $200,000. M. Klein, 65 Court St., archt.

**N. Y., Brooklyn**—One Hundred Seventy-Six Clarkson Avenue, Inc., A. C. Immig, pres., 6 story, 144 x 150 ft., Clark and West Rogers Aves. All separate contracts awarded. $350,000. Holler & Kleinhenz, 1012 Gates Ave., archts.

**N. Y., Brooklyn** — Ten Thousand Ten 4th Avenue Corp., H. Kroll, pres., 57 Riverside Ave., 6 story, 100 x 120 ft., 101st St. and 4th Ave., separate contracts, $200,000. Cohn Bros., 361 Stone Ave., archt.

**N. Y., Brooklyn**—Wavecrest Building Corp., H. J. Spetzen, pres., 16 Court St., 6 story, 84 x 200 ft., Brightwater Court and East 6th St., day labor and separate contracts, $400,000. B. W. Dorfman, 66 Court St., archt.

**N. Y., Brooklyn**—Wanna Realty Co., F. Wilus, pres., 1716 46th St., 6 story, 90 x 100 ft., 16th Ave. and 43rd St. separate contracts, $150,000. J. A. Boyles, 367 Fulton St., archt.

**N. Y., Flushing**—St. Albans Springfield Corp., 160 Jamaica Ave., 2 story, 33rd Ave. and 34th St., separate contracts, $160,000. W. C. Winters, 2772 Fulton St., Brooklyn, archt.

Buildings—Residential (Continued)

**N. Y., Flushing** — Terra Constr. Co., 1440 Bway., New York, 6 story, 86 x 106 ft., 164th and Crocheron Ave., separate contracts, $200,000. C. P. Cannella, 1163 Herkimer St., Brooklyn, archt.

**N. Y., Forest Hills**—Cord Meyer Development Co., 108 Queens Blvd., Long Island City, 6 story, 98 x 182 ft., 108th, St., Continental and 68th Aves., separate contracts, $200,000. T. Engelhardt, 101 West 31st St., New York, archt.

**N. Y., Forest Hills**—I. M. B. Holding Corp., I. M. Halt, pres., 26 Court St., Brooklyn, 6 story, 85 x 128 ft., Austin St. and Ascan Ave., separate contracts, $275,000. B. Braunstein, 163-18 Jamaica Ave., Jamaica, archt.

**N. Y., Jamaica**—J. Moss, 163 Jamaica Ave., 2 story, Sunrise Hy. and 231st Pl., separate contracts, $200,000. D. J. Levinson, 163-18 Jamaica Ave., archt.

**N. Y., Maspeth**—Venster Constr. Corp., 350 Stone Ave., Brooklyn, 2 story, brick, timber, 53rd Ave. and 62nd St. day labor and separate contracts, $150,000. M. Kassovitt, 350 Stone Ave., Brooklyn, archt.

**N. Y., New York**—Active Property Corp., B. L. Karliner, pres., 9 East 40th St., 18 story, brick, steel, 1345 1st Ave. and 355 East 72nd St., to H. R. H. Constr. Co., 9 East 40th St. Est. $650,000. Contractor now taking bids on separate contracts.

**N. Y., New York** — Amsterdam Apartments, Inc., P. Grassi, pres., 271 Madison Ave., 16 story, 50 x 122 ft., 361 West 23rd St., separate contracts and day labor, $600,000. A. P. Hess, 331 Madison Ave., archt.

**N. Y., New York** — Barnes Avenue Realty Corp., S. J. Bernstein, pres., 1500 Boston Rd., 6 stoyr. Barnes Ave. and Pelham Parkway, separate contracts, $750,000. N. Rotholz, 2419 Webster Ave., archt.

**N. Y., New York**—Bandes Stillman Constr. Co., L. Bandes, pres., 2419 Webster Ave., 6 story, 109 x 155 ft., River Ave. and 153rd St., separate contracts, $250,000. N. Rotholz, 2419 Webster Ave., archts.

**N. Y., New York**—Hyorle Building Corp., S. Cohen, pres., 1506 Jerome Ave., 6 story, 122 x 140 ft., Grand Concourse and 197th St., separate contracts, $500,000. H. Ginsberg, 205 East 42nd St., archt.

**N. Y., New York** — M. Horowitz Building Corp., 2037 Webster Ave., 6 story, 107 x 210 ft., Gunhill Rd. and Wayne Ave., separate contracts, $300,000. C. Kreymborg, 2538 Madison Ave., archts.

**N. Y., New York**—Kimbleau Holding Co., T. Moffa, pres., 14 West Tremont Ave., 4 story, 87 x 175 ft., Mathews and Lydig Aves., separate contracts, $170,000. G. W. Swiller, 4215 3rd Ave., archt.

**N. Y., New York**—Krumholz Bros., 349 East 149th St., two 6 story, 44 x 85 ft., brick, timber, Wallace and Barnes Aves., separate contracts, $700,000. Becker & Levy, 349 East 149th St., archts.

**N. Y., New York**—Lerber Constr. Co., 2140 Mapes Ave., 6 story, 200 x 241 ft., Cruger, Brady and Holland Aves., separate contracts, $850,000. N. Rotholz, 2419 Webster Ave., archt.

**N. Y., New York**—Marfran Realty Corp., I. Williams, pres., 1440 Bway., 4 story, 87 x 112 ft., Evergreen and Watson Aves., separate contracts, $900,000. G. G. Miller, 545 5th Ave., archt.

**N. Y., New York** — J. McNulty, 282 East 206th St., 5 story, basement, 90 x 114 ft., Carpenter Ave. and 228th St., separate contracts, $250,000. C. Schaefer, Jr., 332 East 149th St., archt.

**N. Y., New York** — One Thousand Seven Hundred and Five St. Nicholas Avenue, Inc., A. J. Schwarzler, pres., 6 story, 118 x 150 ft., 1677 St. Nicholas Ave., separate contracts, $350,000. C. Schaefer, Jr., 332 East 149th St., archt.

**N. Y., New York**—Philsam Building Corp., I. Belkind, pres., 106 Fort Washington Ave., 6 story, 99 x 125 ft. apartments, Gerard Ave. and 161st St., separate contracts, $250,000. H. I. Feldman, 15 West 44th St., archt.

**N. Y., New York** — Pontiac Development Corp., M. Resnick, secy., 1205 Southern Blvd., 6 story, 77 x 177 ft., Pontiac Pl. and Trinity St., separate contracts, $237,000. C. Kreymborg, 2534 Marion Ave., archt.

**N. Y., New York**—Schulder Realty Co., M. Schultz, pres., 558 8th Ave., 6 story, 102 West 79th St., separate contracts, $150,000. Hillberg & LaValla, 41 East 42nd St., archts.

**N. Y., New York**—Stanton Development Corp., J. Klinger, pres., 1102 1st Ave., 6 story, 191 Stanton Ave., separate contracts, $150,000. L. R. Uffner, 202 West 40th St., archt.

**N. Y., New York**—Stanton Housing Corp., L. Schumacher, pres., 1102 1st Ave., 6 story, incl. stores, 193 Stanton St., separate contracts, $150,000. L. R. Uffner, 202 West 40th St., archt.

**N. Y., New York**—Two Thousand Three Hundred Twenty Aqueduct Avenue, Inc., owner and archt., H. Gugig, pres., 1307 Boscobel Ave., apartment, Aqueduct Ave. and Evelyn Pl., separate contracts, $200,000.

**N. Y., New York**—Two Hundred Seventy-Five East 239th Street, Inc., M. Horgan, pres., 305 East Kingsbridge Rd., 4 story, 239th St. and Katonah Ave., separate contracts, $850,000. J. P. Boyland, 305 East Kingsbridge Rd., archt.

**N. Y., Richmond Hill**—E. Buff, 8915 102nd St., 6 story, 89 x 119 ft., 120th St. and Liberty Ave., separate contracts, $175,000. Cohn Bros., 361 Stone St., Brooklyn, archt.

**N. Y., Woodhaven**—A. J. Cobb, 9331 85th Rd., 4 story, 63rd Rd. and Woodhaven Blvd., separate contracts, $150,000. W. T. McCarthy, 147 Pierrpont St., Brooklyn, archt.

**Wis., Milwaukee** — Eleventh and Wisconsin Co., 530 Wisconsin Ave., general contract 15 story apartment, 1st floor 66 x 118 ft., 14 floors 66 x 88 ft., to R. L. Reisinger & Co., Richmards St. Est. $600,000. Noted July 24.

## CLUBS

### PROPOSED WORK

**Ark., Little Rock**—Little Rock Y. M. C. A., c/o W. S. Rawlings, pres., 114 East 14th St., plans by Thompson, Sanders & Ginocchio Hall Bldg., 3 story, 100 x 140 ft., rein.-con., brick, Colonial design, 4th and Scott Sts.

**Mass., Falmouth**—F. T. Lawrence, Locust St., beach club, $150,000.

**Mich., Detroit**—See "Excavation, Drainage, Irrigation, Levees, River and Harbor."

**Nev., Las Vegas**—Las Vegas Masonic Lodge Assn., plans by G. S. Underwood, California Reserve Bldg., Los Angeles, Calif., 2 story, basement, rein.-con, lodge, $150,000.

**N. J., Jersey City**—Western Slope Democratic Club, Inc., 41 Nelson Ave., altering and constructing 2 story addition, $150,000.

**N. Y., Brooklyn**—St. Peters Clavers Roman Catholic Church, 27 Claver Pl., plans by H. V. Murphy, 208 Livingston St., 4 story, 100 x 112 ft. community center, Jefferson Ave. and Claver Pl. $450,000.

**N. Y., New York**—National Bureau Y.M.C.A., 547 Madison Ave., bids in October, 10 story railroad branch Y.M.C.A., 220 East 47th St. $1,000,000. Warren & Wetmore, 16 East 42nd St., New York, archts. Noted Aug. 28.

**N. C., Greensboro**—Civic Center Corp., C. L. Van Noppen, pres., plans by C. C. Hartman, Jefferson Bldg., Hotel Van Noppen, West Gaston and Eugene Sts. $600,000.

**O., Hamilton**—Y. M. C. A., 3rd and Dayton Sts., bids late in October, general contract club, Dayton St. A. Ware, 1170 Bway., New York, archt. Noted July 10.

**Tex., San Antonio**—Swiss Plaza Club, c/o A. L. Adams, chn. building comn., 437 Bedell Bldg., plans by Phelps & DeWees, Gunter Bldg., City Federation of Women's Clubs, 11 story, basement, tower, rein.-con., steel, brick, stone, 7th St. and Avenue A. $450,000.

### BIDS ASKED

**Calif., Long Beach**—W. H. Austin, archt., Pacific Southwest Bldg., and Shilling & Shilling, archts., Long Beach, taking bids and open same about Sept. 12, 3 story, basement, 80 x 150 ft., rein.-con., Cedar Ave., for B.P.O.E. 888, $350,000. Noted Aug. 7.

### CONTRACTS AWARDED

**N. J., Newark**—Eight Hundred Twenty-Five Holding Corp., c/o G. E. Jones, archt., 24 Commerce St., general contract 2 story, basement, 50 x 175 ft., brick, steel, Reed and Providence Sts., to Eustice Bros., Inc., 11 Academy St. Est. $150,000. Noted Aug. 21.

## HOSPITALS

### PROPOSED WORK

**Calif., Riverside**—California Mission Springs Sanitarium, c/o Hiller & Sheet, archts., Story Bldg., Los Angeles, fireproof sanitarium, incl. swimming pool, hotel, $1,000,000.

**Mass., Boston**—City, Hospital Dpt., plans by J. H. Ritchie & Associates, 250 Stuart St., Children's Building, Boston City Hospital Unit, $500,000.

**N. Y., New York**—E. Gould Foundation for Children, 598 Madison Ave., plans by W. O. Tait, 47 Rossmore Ave., 2 and 3 story, 77 x 119 ft., hospital, Stillwell and Pelham Parkway, $150,000.

**Tenn., Memphis**—City John Gaston Memorial Hospital, $500,000.

**Tex., New Braunfels**—Southland Nature Cure Sanatorium, Inc., c/o R. C. Reynolds, doctor, New Braunfels, bids after Oct. 1, 2 story, rein.-con., hollow tile, Spanish Colonial type sanatorium, $150,000. H. P. Smith, c/o Natl. Bank of Commerce Bldg., San Antonio, archt.

**Tex., San Antonio**—San Antonio State Hospital, South Presa St., plans by L. M. J. Dielman, 306 East Commerce St., improving state hospital, incl. new ward and dormitory building, enlarging psychopathic hospital, all brick, concrete, some new heating equipment, sanitary units, $175,000.

### BIDS ASKED

**Calif., Stockton**—Sept. 29, by Bd. Comrs. San Joaquin Co., E. D. Graham, clk., rein.-con., steel brick hospital, $250,000.

**Ind., Newcastle** — Sept. 22, by Village of Epileptics, rein.-con., brick, slate, steel, stone hospital, $150,000. Noted July 17, under "Public."

**Pa., Phila.**—Sept. 16, by Dpt. P. Health, A. A. Cairns, dir., City Hall Annex, 5 story, basement, 116 x 500 ft., rein.-con., brick, steel, limestone tuberculosis hospital, plain found., 34th and Pine Sts. P. H. Johnson, Widener Bldg., archt.

### CONTRACTS AWARDED

**Mass., Everett**—City, M. C. O'Neil, City Hall, 3 story, basement, 45 x 190 ft., brick, stone, concrete, steel hospital, concrete found., to Bond Bros., 79 Ferry St. Est. $350,000. Noted June 26.

**Mass., Malden** (bc. Boston)—Malden Hospital, E. P. Bliss, chn. comn. in charge, 3, 4, 5 story, basement, irregular sized brick, stone, steel hospital group, plain founds., to Thos. O'Connor & Co., 238 Main St., Cambridge. Total est. $1,000,000. Noted Sept. 4.

**Neb., Grand Island**—D. X. Murphy, archt., 707 Louisville Trust Bldg., Louisville, Ky., 4 story, basement, 46 x 80 ft., and 46 x 102 ft., brick, concrete, stone hospital addition and chapel wing, to P. Sothman, Grand Island, $196,099; heating and plumbing, to Grand Island Plumbing Co., Grand Island, $43,788; electrical wiring, to City Light Dpt., Grand Island, $10,642. Grand total $250,529.

**N. Y., Brooklyn**—Delsim Corp., 61 Greene Ave., 6 story sanitorium, to W. Kennedy Constr. Co., 215 Montague St. Est. $200,000. Excavation underway. Noted June 27.

**Ont., London**—St. Joseph's Hospital, general contract 4 story, basement, 40 x 350 ft., white brick, rein.-con. addition, to John Hayman & Sons, 422 Wellington St. $350,000.

## CHURCHES

### PROPOSED WORK

**Calif., Pasadena**—Lake Avenue Congregational Church, H. Hutchinson, pastor, sketches by Marston & Maybury, 25 South Euclid Ave., Class A, Lake Ave. and Maple St. $200,000.

**Mass., South Byfield**—South Byfield Methodist Church, J. F. Scott, pastor, plans by Derby, Barnes & Champney, 3 Joy St., Boston, rebuilding church, recently destroyed by fire. $150,000.

**N. Y., New York** — Franciscan Poor Clares, 328 Haven Ave., plans by R. J. Reiley, 12 East 41st St., 3 story, 156 x 183 ft., monastery, Hollywood Ave. and Silver Beach Pl. $300,000.

**Pa., Pittsburgh**—All Saints Episcopal Congregation, California Ave., plans by Ingham & Boyd, 1211 Empire Bldg., brick, McClure and Davis Sts. $150,000.

**Pa., Titusville** — St. Titus Roman Catholic Church, 513 West Main St., plans by W. T. Monahan, 805 Palace Hardware Bldg., 1 story, balcony, basement, 44 x 146 ft., rein.-con., steel, art glass, incl. pipe organ, West Main St. $150,000.

**Ont., Toronto**—St. Timothys Anglican Church, H. Marsh, pastor, 28 Deloraine Ave., plans by George, Moorhouse & King, 1123 Bay St., 1 and 2 story, basement, concrete, brick, stone, steel church, parish house, Ridley Blvd. $150,000.

### BIDS ASKED

**Mass., Arlington**—W. N. Colleary, archt., 80 Boylston St., Boston, taking bids 1 story, basement, brick, stone, granite, Appleton St., for St. James Parish, M. J. O'Connor, pastor, $150,000-$160,000. Noted July 31.

**N. J., Red Bank**—N. Hulme, archt., 1524 Chestnut St., Phila., Pa., bids about Sept. 15, general contract 2 story, basement, brick, steel, LeRoy Pl. and Broad St., for 1st Methodist Church of Red Bank, F. A. DeMaris, rector, $250,000. Noted Aug. 7.

**Que., Sherbrooke**—Roman Catholic Parish of Notre Dame taking bids superstructure 75 x 205 ft., granite church. J. A. Poulin, King St., archt.

### CONTRACTS AWARDED

**Calif., Los Angeles**—St. Thomas Church, concrete, Hollywood Blvd., to R. S. Martin, 522 East Bway., $150,000.

**Ind., Indianapolis** — Christian Church, 62nd St. and Indiana Ave., general contract Broad Ripple Christian Church, brick, steel, 62nd St. and Ashland Ave., to J. Eubank, 5759 Ashland Ave. Est. $150,000.

**Ind., Indianapolis**—Luthern Church, 52nd St. and Central Ave., general contract Bethlehem Lutheran Church, rein.-con., stone, 52nd St. and Central Ave., to Foster Eng. Co., 726 Indiana Pythian Blvd. Est. $150,000.

**Mass., Lawrence**—Anshe Sholem Synagogue, L. Pearl, pres., Hampshire St., altering and constructing 1 story, basement, brick, stone, steel addition, plain found., to J. A. Torrisi, 103 Haverhill St. Est. $150,000. Noted Aug. 7.

**Mass., North Attleboro** — Grace Episcopal Church, G. E. Osgood, pastor, 1 story, basement, brick, stone, to Munroe & Westcott, Inc., 28 Washington St. Est. $150,000. Noted July 17.

## SCHOOLS

### PROPOSED WORK

**Calif., Los Angeles**—Bd. Educ. Los Angeles School Dist. plans by A. S. Nibecker, Jr., 1624 Bushnell St., South Pasadena, fireproof, 32nd St. $150,000.

**Ky., Louisville**—Bd. Educ., plans by J. M. Cooley, 8th and Chestnut Sts., James R. Lowell School, 2 story, basement, rein.-con., brick, steel, Phillips Lane and Ashbottom Rd. $250,000-$300,000.

**Mass., Arlington** (sta. Boston)—Town, E. F. Barker, chn. Building Comn., sketches by G. E. Robinson, 80 Federal St., Boston, 2 story, basement, brick high school addition, $275,000.

**Mass., Cambridge**—Harvard University plans by Coolidge, Shipley, Bulfinch & Abbott, Ames Bldg., Boston, altering and constructing brick addition to dormitory "Winthrop House" To exceed $150,000.

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Schools (Continued)

**Mass., Quincy**—City Bd. Educ., H. M. Muir, supt. schools, plans by Harper & West, 93 State St., Boston, 2 story, basement, brick, steel addition, Abigail St. and Madison Ave. $150,000.

**Mass., Worcester**—Commonwealth of Massachusetts, Dpt. Educ., P. Smith, State House, Boston, plans by Frost, Chamberlain & Edwards, 390 Main St., and soon takes bids 2 story, 132 x 220 ft., brick, steel, concrete, limestone normal school, Chandler and May Sts. $350,000. Noted Feb. 20.

**Minn., St. Paul**—St. Joseph's Academy, Western Ave. and Nelson St., 4 story, basement, brick, rein.-con., Virginia and Iglehart Aves. $250,000.

**N. J., Fair Lawn**—Bd. Educ. 2 story, basement, brick, steel, rein.-con., Henderson Terrace Sect. $150,000. Architect not selected.

**N. J., Union City** — Holy Family Roman Catholic Church, J. N. Grief, pastor, c/o F. J. Ricker, archt., 685 Hudson Ave., West New York, 3 story, basement, 70 x 150 ft. high school addition, 32nd St. and Central Ave. $250,000. Noted Sept. 4.

**Pa., Beaverdale**—Bd. Educ. Sommerhill Twp. plans by Rinthcum & Rinthcum, Wash., D. C., 1 story, 70 x 156 ft., brick grade and high school. $150,000.

**Pa., Grove City**—Grove City College plans by R. A. Eckles, New Castle, dormitory, $500,000, and brick school, concrete pile found., $250,000.

**R. I., Middletown**—St. George's School, c/o Howe & Church, archts., Turks Head Bldg., Providence, sketches brick infirmary. $150,000.

**Tenn., Memphis**—Bd. Educ., W. J. Prescott, pres., sketches Snowden Junior High School. $355,000.

**BIDS ASKED**

**Ill., Alton**—St. Mary's Roman Catholic Parish, c/o J. J. Brune, pastor, bids about Sept. 30, 3 story, basement, 51 x 123 ft. x 57 x 121 ft. irregular shaped, rein.-con., brick school, also 2 story, basement, 51 x 82 ft. sisters' home, 3rd and Henry Sts. $200,000. H. P. Hess, 1001 Ambassador Bldg., St. Louis, Mo., archt.

**Ill., Chicago**—Sept. 23, by Bd. Educ., 188 West Randolph St., E. Withall, mgr., Senior High School, Barry and Melvina Sts. P. Gerhardt, c/o owner, archt.

**Ill., Chicago** — University of Chicago, 122 South Michigan Ave., bids about Sept. 27, dormitories, incl. series quadrangle buildings, 4 dining rooms, facing Midway between Ellis and Greenwood Aves. $3,000,000. Zantzinger, Borie & Medarie, Otis Bldg., Phila., Pa., archts. Noted May 13.

**Ind., Ft. Wayne** — Oct. 1, by Bd. School Comrs., rein.-con., brick, $150,000. C. Carlson, 1225 Clinton St., archt. Noted July 3.

**Ia., Ft. Dodge**—Bd. Educ., E. E. Peterson, secy., revised plans by F. W. Griffith, 400 Snell Bldg., and E. O. Damon, Jr., 19 East Mason Bldg., and takes bids about Sept. 20, Junior High School, 2 story, basemnt, rein.-con., brick, stone, $225,000. Former bids rejected. Noted Sept. 4.

**Ia., Waterloo**—Bd. Educ., W. C. Logan, secy., 405 Pioneer Natl. Bldg., bids about Sept. 15, Lowell Grade School, 2 story, 107 x 238 ft., rein.-con., brick, stone, steel, tile, terrazzo, marble, Washington Ave. $175,000. Ralston & Ralston, 218 Pioneer Natl. Bldg., archts. Noted July 31.

**La., Rayville**—Richland Parish School Bd., J. A. Bell, pres., bids about Sept. 23, 3 story, basement, rein.-con., brick, stone, concrete found. $175,000. E. F. Neild, City Bank Bldg., Shreveport, archt.

**Mass., Cambridge**—Sept. 12 (extended date), by Coolidge, Shepley, Bulfinch & Abbott, archts., 122 Ames Bldg., Boston, 4 story, basement, brick, granite, limestone dormitory group, Kirkland House, Dunster and South Sts., for Harvard University, A. Lawrence Lowell, pres. $150,000 or more. Noted Sept. 4.

**Mass., Yarmouth** — Town, School Building Comn., taking bids 2 story, basement, brick, stone, plain found., South Yarmouth Sect. Est. exceeds $150,000. J. H. Ritchie & Associates, 250 Stuart St., Boston, archts. Noted July 31.

**Mich., Capac** — Sept. 16, by E. McAndless, secy. Bd. Educ., 2 story, basement, 70 x 155 ft., brick, steel, rein.-con., plain found. $150,000. Warren St. Holmes Co., Lansing, archts.

**Mich., Detroit**—Sept. 18, by C. A. Gadd, bus. mgr., Bd. Educ., 1354 Broadway Ave., 2 story, basement, brick, steel, stone, rein.-con. high school, plain found., Martin Ave. $250,000. N. C. Sorensen, 2231 Park Ave., archt.

**Mo., Ferguson**—Sept. 16, by Bd. Educ., (1st unit) 2 story, basement, 74 x 112 ft., rein.-con., brick high school, concrete found. W. B. Ittner, Inc., Continental Life Bldg., St. Louis, archt. Noted Sept. 4.

**N. J., Hillside** (sta. Elizabeth)—Bd. Educ., H. W. Doremus, pres. Township Hall, bids about Oct. 15, 2 story basement, brick, steel, rein.-con., Leslie St. and Winans Ave. $165,000. J. Wind, Jr., 1450 North Broad St., archt. Noted Aug. 28.

**N. J., New Brunswick**—Bd. Educ. Livingston Ave., bids about Oct. 1, 2 story basement, brick steel addition to Senior High School, plain found., Livingston Ave. $150,000. A Merchant, 1 Elm Row, archt. Noted July 24.

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**N. Y., Buffalo** — Sept. 25, by Bd. Educ., School 83, Montcalm and Montrose Sts. D. McNeill, Genesee Bldg., archt.

**N. Y., Dongan Hills** (sta. Staten Island) — Sept. 18, by W. C. Martin, archt. and supt. School Buildings, Flatbush Ave. extension and Concord St., Brooklyn, general contract P. S. 11, Jefferson St. between Garretson and Cromwell Aves., for Bd. Educ., 500 Park Ave., New York.

**O., Oberlin** — Sept. 12, by C. W. Frank, archt., 8 Adolph St., Akron, two 3 story, basement, 43 x 172 ft., brick, steel, concrete dormitories. $400,000.

**Pa., Washington**—Sept. 20, by Bd. Educ., R. C. Buchanan, pres., Jefferson and Wylie Aves., Junior and Seninor High School, 3 story, basement, 62 x 350 ft. main building, 2 story, basement, 72 x 125 ft. shop building, 2 story, basement, 86 x 104 ft. auditorium, 2 story, basement, 72 x 165 ft. gymnasium and pool, brick, hollow tile, Allison St., Jefferson and West Hallam Aves. $900,000. C. L. Woolridge, Fulton Bldg., Pittsburgh, consult. engr. E. P. Lee, 1210 Chamber of Commerce Bldg., Pittsburgh, archt. Noted Apr. 24.

**Tex., Denton** — College of Industrial Arts, c/o H. Fitzgerald, bids about Nov. 15, brick, rein.-con., stone dormitory. H. C. Knight, Wilson Bldg., Dallas, archt.

**CONTRACTS AWARDED**

**Del., Oxford**—Lincoln University, c/o Chester Co. School Auxiliary, A. J. Taylor, in charge, Du Pont Bldg., Wilmington, general contract 3 story, basement, 65 x 125 ft. boys' dormitory, brick, steel, plain found., to Yardley Constr. Co., Schaff Bldg., Phila., Pa. Est. $150,000. Noted Aug. 28.

**Kan., Belleville** — Bd. Educ., W. O. Stark, pres., general contract 2 story, basement, 147 x 162 ft., rein.-con., brick, stone high school, to A. Helwig, Hoisington, $89,336. Noted Aug. 21.

**La., Vivian**—Caddo Parish School Bd., E. W. Jones, supt., 2 story, basement, rein.-con., brick addition, incl. gymnasium, cafeteria, to F. C. McClanahan, Homer, $95,212. Noted Aug. 14.

**Md., Baltimore**—Smith & May, archts., Calvert Bldg., 3 story, basement, irregular sized, brick, steel, concrete, cut stone law building, to Consolidated Eng. Co., 20 East Franklin St., for University of Maryland, Lombard and Greene Sts., $155,000. Noted Aug. 14.

**Mass., Cambridge**—Coolidge, Shepley, Bulfinch & Abbott, archts., Ames Bldg., Boston, 3 units, Freshman Dormitories, 3 story, basement, 40 x 75 ft., 40 x 136 ft., and 40 x 176 ft., brick, stone, steel, plain founds., to I. G. Hersey & Sons Co., 75 Wareham St., Boston, est. $500,000; electrical work, to Lord Electric Co., 303 Columbus Ave., Boston, est. $25,000 or more; heating and plumbing, to T. J. Murphy & Co., 8 Walden St., Cambridge, est. exceeds $25,000. Noted Aug. 28.

**Mass., New Bedford**—E. B. Hammond, chn., North Water St., 2 and 3 story, basement, 60 x 170 ft., brick, concrete, steel vocation school for girls, to Central Eng. & Constr. Co., Pawtucket, R. I., $167,888. Noted May 22.

**Okla., Oklahoma City**—J. G. Stearley, clk. Bd. Educ., general contract Wm. Howard Taft High School, 3 story, brick school, omitting gymnasium, swimming pool, to Musgrave Constr. Co., Cotton Exch. Bldg., $195,352. Noted Aug. 28.

**Pa., Morganza**—Comrs. Pennsylvania Training School, general contract two cottages, one for boys and other for girls, to Building Service Co., Johnstown. Est. $200,000. Noted July 24.

**Pa., Villanova** — P. Monaghan, archt., 1520 Locust St., Phila., School of Commerce, 3 story, basement, 89 x 166 ft. and 48 x 89 ft., brick, steel, stone, plain found., to F. V. Warren Co., 15th and Locust Sts., Phila., for Augustian College. Noted Aug. 21.

**Wis., Waukesha**—Bd. Vocational Educ., 1 and 2 story, basement, 120 x 174 ft., brick, vocational school, Maple St., to J. Lorenz, 2326 Vliet St., sublet carpentry contract, to M. Mravik, Milwaukee; masonry, to C. Gordif, Waukesha; plastering, to G. Ward, Waukesha; cut stone, to P. Schmidt & Co., 33rd and Harrison St., Milwaukee; tile and terrazzo, to American Marble Mosaic Co., 1740 Edison St.; steel, to G. Hennecke Co., 1353 North Pierce St.; reinforcing, to Truscon Co., 230 Wisconsin Ave.; sash, to Federal Sash Co., 228 3rd St. Noted July 24.

**Que., Montreal** — Roman Catholic School Comn., Lalement School, Fullum St., to Dancereau Ltd., 1387 Bernard St., $172,500.

**Que., Ste. Anne de la Pocatierre**—Provincial Dpt. of Agriculture, J. L. Perron, minister, general contract 5 story, 53 x 180 ft., brick, concrete addition to agricultural college, concrete found., to F. X. Lambert, 329 Grand Allee, Quebec City, $300,000.

## THEATRES

**PROPOSED WORK**

**N. Y., Albany** — R. K. O. Theatre, 1664 Bway., New York, soon lets contract theatre, North Pearl St. and Clinton Ave. $3,000,000. J. Eberson, 370 Lexington Ave., New York, archt. Noted July 3.

**La., Lafayette**—Southern Amusement Co., c/o Jefferson Theatre, soon lets contract 1 story, mezzanine, balcony, 1,200 seating capacity, concrete, brick. H. J. Duncan, 120 Murray St., Alexandria, archts.

**N. Y., Schenectady**—R. K. O. Theatres, 1564 Bway., New York, soon lets general contract theatre, $150,000. J. Eberson, 370 Lexington Ave., New York, archt. Noted July 3.

**BIDS ASKED**

**Calif., San Francisco**—Miller & Pflueger, archts., 580 Market St., taking bids steel, rein.-con. theatre, Ocean Ave., for S. Lavin, c/o architects. $250,000.

## BANKS

**PROPOSED WORK**

**N. J., South Orange**—Myers & Shanley, archts., 24 Walnut St., Newark, rejected bids Aug. 4, altering and constructing 2 story addition, for South Orange Trust Co., 33 South Orange Ave. $150,000. Noted July 31.

**N. Y., Syracuse**—Onondaga County Savings Bank, plans by Halsey, McCormack & Helmer, Inc., 286 5th Ave., New York, altering bank. $500,000.

**Vt., Burlington**—Harper & West, archts., 92 State St., Boston, Mass., soon lets contract 2 story, basement, brick, concrete, marble, College St., for Chittendon County Trust Co., E. J. Booth, pres., 114 Church St. $200,000. Noted Sept. 4.

**BIDS ASKED**

**Mont., Helena**—Sept. 15, by E. A. Tyler, dir. constr., 1st Bank Stock Corp., 602 Merchants Natl. Bank Bldg., St. Paul, Minn., 4 story, basement, rein.-con., brick, stone bank and office, for Owner affiliated with 1st Bank Stock Corp. $350,000. Shanley, Wilson & Hugenin, Butte, archts.

**CONTRACTS AWARDED**

**N. Y., Brooklyn** — East New York Savings Bank, E. A. Richards, pres., superstructure bank, to Caye Constr. Co., 356 Fulton St. Est. $150,000. Soon lets contract interior work. Noted July 10.

## OFFICES

**PROPOSED WORK**

**Calif., Inglewood**—Los Angeles Gas & Electric Co., 810 South Flower St., Los Angeles, 2 story, basement, brick, steel. $150,000. Engineering Department of owners, engrs.

**Calif., Los Angeles**—Owner, c/o S. C. Lee, archt., 531 Petroleum Securities Bldg., 8 story, basement, 70 x 150 ft., rein.-con., steel, plate glass, terra cotta, Wilshire and San Vicente Blvds. $350,000.

**Calif., Los Angeles**—Los Angeles Times, 100 North Bway., sketches by G. B. Kaufmann, 610 Union Bank Bldg., 12 story, basement, 270 x 320 ft., rein.-con., steel, terra cotta, tile, marble, 1st St. between Bway. and Spring Sts. To exceed $150,000.

**Calif., Oakland**—Owner, c/o F. H. Reimers, archt., Franklin Bldg., 3 story, basement, brick, steel, medico-dental building, 34th St. and Bway. $175,000.

**Mich., Holland**—Holland Furnace Co., Holland, plans by F. E. Davison, Monadnock Blk., Chicago, Ill., 3 story, part basement, 40 x 250 Columbia Ave. $250,000.

**N. J., Newark** — Majestic Radio Co., 259 Madison Ave., Perth Amboy, plans by W. E. Lehman, 972 Broad St., 2 story, basement, 40 x 250 ft., brick, steel, incl. showrooms, warehouse, Frelinghuysen Ave. $150,000. Noted Sept. 4.

**N. Y., New York**—Corporation, c/o S. Friedman, 15 West 47th St., plans by Springsteen & Goldhammer, 40 East 49th St., 28 story, 131 x 139 ft., brick, steel, rein.-con., incl. stores, 90 John St. and 24 Gold St. $2,000,000.

**N. Y., New York**—One Hundred Twenty-Two Water Street Corp., L. Adler, pres., 550 7th Ave., plans by E. J. Kahn, 2 Park Ave., 65 story, 141 x 193 ft. office, stores, Wall, Pine, Pearl and Water Sts. $10,000,000. Noted May 15.

**N. Y., New York** — United States Land & Impvt. Co., 1463 Bway., plans by E. C. Faber, 784 Park Ave., 23 story, 49 x 86 ft. top addition, rein.-con., brick, 1465 Bway. $920,000.

**Ont., Toronto**—Toronto Hydro-Electric System, P. E. Hart, ch. engr., 225 Yonge St., concrete, brick, stone, steel office and administration building. $1,000,000.

**BIDS ASKED**

**N. J., Passaic**—See "Contracts Awarded."

**CONTRACTS AWARDED**

**Calif., Los Angeles**—Corday & Broder, Los Angeles, 13 story, 88 x 90 ft., rein.-con., marble, tile, granite, ornamental iron, sheet metal, steel medical building, incl. 250 offices, 3 operating rooms, Vermont and De Longpre Aves., to Corday Constr. Co., 618 South Western Ave. $750,000.

**N. J., Passaic**—Pub. Serv. Gas & Electric Co., 80 Park Pl., Newark, 2 story, basement, 90 x 160 ft., brick, steel, incl. store room, 52-58 Columbia Ave., separate contracts. $170,000. C. W. Fairweather, c/o owner, archt.

**Okla., Bartlesville** — Phillips Petroleum Co., general contract 1 story top addition to present 7 story, concrete, brick, steel office building, 8 story, 40 x 40 ft. and 12 story, 40 x 40 ft. wings, to Rucks-Brandt Constr. Co., Mid-Continent Bldg., Tulsa; plumbing and heating, to Sell-Ore Plumbing & Heating Co., Independence, Kan.; electric wiring, to Allen Electric Co., 114 West 5th St., Tulsa; structural steel, to Kansas City Structural Steel Co., 21st and Metropolitan Sts., Kansas City, Kan. Est. $360,000.

Offices (Continued)

**Okla., Oklahoma City** — Starrett Investing Corp., 101 Park Ave., New York, and 9 South Dearborn St., Chicago, Ill., 31 story, basement, 100 x 140 ft., brick, steel, concrete pile found., 1st and Robinson Sts., to Starrett Bros., 101 Park Ave., New York, and 9 South Dearborn St., Chicago. Est. $3,000,000. No date set for separate contracts.

**Va., Richmond** — Corporation, L. T. Price, pres., altering 7 story and constructing 1 story top addition to Professional Building, to 5th and Franklin Sts., to Wise Granite & Constr. Co., American Natl. Bank Bldg., $150,000.

## STORES

### BIDS ASKED

**N. J., Jersey City**—M. A. Wolf, archt., 845 Broad St., Newark, and A. Cordano, c/o architect, bids about Oct. 1, general contract 3 story, basement, brick, steel stores, apartment, Manhattan and Terrace Aves., $150,000. Noted Sept. 4.

### CONTRACTS AWARDED

**Mass., Boston**—Jordan Marsh Co., 450 Washington St., altering 3 story, basement, brick, concrete, steel department store, incl. concrete, steel entrance to Washington St. Subway, to J. F. Fitzgerald Constr. Co., 38 Chauncy St.

**Pa., Uniontown**—G. C. Murphy Co. (E. M. Mack, in charge) 533 5th Ave., McKeesport, Store 164, 2 story, 50 x 150 ft., brick, tile, steel, concrete, 13 East Main St., to Blair & Mack, 920 Market St., McKeesport. Est. $150,000.

## PUBLIC

### PROPOSED WORK

**Calif., San Francisco**—AMERICAN LEGION MEMORIAL—City and San Francisco Co., plans by G. A. Lansburgh, 140 Montgomery St., and A. Brown, 251 Kearny St., and takes bids about Jan. 1, 4 story, basement, rein.-con., brick, steel, Civic Center. $2,500,000.

**Calif., San Francisco**—OPERA HOUSE—City and San Francisco Co., plans by G. A. Lansburgh, 140 Montgomery St., and A. Brown, Jr., 251 Kearny St., 6 story, Class A opera house, Civic Center. $2,500,000.

**N. J., Glen Ridge**—MUNICIPAL—Bd. Boro Council, Boro Hall, sketches by W. O. Bartlett, archt., 24 Commerce St., Newark, 2 story, basement, brick, steel, Bloomfield and Ridgewood Aves. $175,000. Noted Dec. 5.

**N. Y., Brooklyn** — COURT HOUSE — H. Hesterberg, pres. Brooklyn Boro, bids early in October, 3 story magistrates and municipal court house, 4th Ave. and 42nd St. $475,000. M. D. Metcalfe, Bedford and Atlantic Aves., archt. Noted July 10.

### BIDS ASKED

**Calif., Los Angeles**—OFFICE—Sept. 30, by State Dpt. P. Wks., Sacramento, general contract 12 story, 88 x 168 ft., rein.-con., granite, terra cotta, marble, tile, steel, Civic Center. Noted July 31.

**D. C., Wash.**—OFFICE—Oct. 28, at office D. Lynn, archt. of Capitol, 10 story, sub-basement, stone, for House of Representatives, Square 689; adv. E. N.-R. Sept. 11.

**Mass., Woburn**—CITY HALL, etc.—Sept. 19, at Mayor's Office by City and Comrs. Middlesex Co., lessee, 2 story, basement, brick, stone city hall, police station, court house, plain found., Common St. $250,000. M. A. Dyer & Co., 1 Beacon St., Boston, archts.

**N. Y., Attica**—CELL BLOCK—Sept. 18, by Commissioner Correction, State Office Bldg., Albany, Cell Block B, Attica State Prison; adv. E. N.-R. Sept. 11.

**Okla., Muskogee**—CITY HALL—See "Contracts Awarded."

### CONTRACTS AWARDED

**Mass., North Adams**—ARMORY—Commonwealth of Massachusetts, Armories Div., State House, Boston, 2 story, basement, 85 x 160 ft., granite, limestone, plain found., to Gordon & Sutton, 884 Main St., $124,000. Noted Aug. 21.

**Okla., Muskogee**—CITY HALL—City, c/o Mayor, 3 story, basement, rein.-con., brick, stone, plain found., day labor under supervision Manhattan Constr. Co., Manhattan Bldg., Muskogee. Est. $250,000. This corrects report in Aug. 21 issue.

**S. D., Philip**—COURT HOUSE—J. S. Snow, aud. Haakon Co., 4 story, basement, to S. W. Jonason Co., Aberdeen, $83,290. Noted Aug. 14.

## BUILDINGS—UNCLASSIFIED

### PROPOSED WORK

**Conn., Bristol**—EXCHANGE—Southern New England Telephone Co., 157 Church St., New Haven, plans by D. Orr, 956 Chapel St., New Haven, 2 story, basement, 80 x 115 ft., brick, steel, Main St. $150,000.

**Mass., Lynn** — EXCHANGE — New England Telephone & Telegraph Co., 50 Oliver St., Boston, plans by Densmore, Le Clear & Robbins, Park Sq. Bldg., Boston, 3 story, basement, 16,500 sq.ft. floor space, brick, stone, concrete, plain found., Essex and Washington Sts. To exceed $150,000. Noted June 26.

**N. Y., Brooklyn** — MOTION PICTURE STUDIO—Warner Bros. Pictures, 321 West 44th St., New York, general contract 3 story, 207 x 207 ft., brick, 1262 East 14th St. $400,000. T. W. Golding, 597 5th Ave., New York, archt. Project postponed until after Jan. 1. Noted May 29.

**N. Y., New York**—GARAGE—Kent Garages Investment Co., 350 Madison Ave., garage, $1,000,000. Plans to be revised. **Maturity indefinite.** Noted Apr. 24.

**N. Y., New York** — RESTAURANT and KITCHENS — H. Seagel, 1279 East 24th St., Brooklyn, plans by L. A. Abramson, 25 West 45th St., restaurant and kitchens, 611 West 181st St. $150,000.

**O., Cincinnati** — PUBLISHING PLANT — Cincinnati Post, c/o Scripps-Howard Co., Union Central Bldg., plans by J. W. Thomas, 3868 Carnegie Ave., Cleveland, 1 story, brick, rein.-con. addition, Elm St. and Post Sq. $200,000.

**Pa., Ambridge**—EXCHANGE—Bell Telephone Co., J. M. Doremus, engr., 416 7th Ave., Pittsburgh, plans by J. T. Windrim, 1501 Commonwealth Bldg., Phila., exchange on 68 x 100 ft. site, 9th and Merchant Sts. $250,000.

**Sask., Regina** — EXHIBITION — Regina Exhibition Assn., c/o D. T. Elderkin, two exhibition buildings, one to be 90 x 1,800 ft., Exhibition Grounds. $400,000.

### BIDS ASKED

**Mo., Kansas City**—EXCHANGE—Sept. 16, by Southwestern Bell Telephone Co., 11th and Pine Sts., St. Louis, and E. T. Mahood, local mgr., Kansas City, 2 story, basement, 78 x 137 ft., rein.-con., brick, steel, 12th and Cleveland Aves., I. R. Timlin, 1916 Telephone Bldg., St. Louis, archt.

**Okla., Tulsa** — EDUCATIONAL — First Christian Church, 9th and Boulder Sts., A. Harris, chn., taking bids 2 story, basement, 85 x 117 ft., rein.-con., brick, plain found., 9th and Boulder Sts. $165,000. Smith & Senter, Philtower Bldg., archts. Noted Aug. 1, 1929.

### CONTRACTS AWARDED

**Mo., Ferguson**—HOME—Mothers and Children Home of Christian Church, 2 story, basement, 110 x 250 ft., brick, concrete, to Boaz-Kiel Constr. Co., 411 North 7th St., St. Louis. Est. $250,000. Noted Aug. 7.

**N. J., Middletown**—EXCHANGE—New Jersey Bell Telephone Co., 540 Broad St., Newark, general contract 2 story, basement, brick, steel, to B. W. Covert, 133 Bergen Pl., Red Bank. $150,000. Noted July 17.

**N. J., Woodbine**—DORMITORY—Dpt. Institutions & Agencies, State Office Bldg., Trenton, general contract 1 and 2 story, basement, 70 x 160 ft., brick, steel, at Colony for Feeble Minded, to Pasquale & Schaible, Vineland. Est. $150,000. Noted Aug. 7.

**N. Y., Buffalo**—TERMINAL WAREHOUSE—Buffalo Terminal Co., c/o G. S. Rider Co., archts., Marshall Bldg., Cleveland, O., 1 and 2 story, 420 x 1,000 ft., brick, rein.-con., to J. W. Cowper Co., Rand Bldg., $1,000,000. Noted July 24.

**Pa., Media**—JAIL—Comrs. Delaware Co., 1, 2 and 3 story, basement, 200 x 600 ft., rein.-con., stone, steel, Broad Meadow Farms, to T. C. Trafford, 2339 North 15th St., Phila., $600,213; heating and ventilating, also plumbing, to N. Connally, 1404 North 18th St., Phila., $37,337 and $59,364 respectively; electrical work, to Conestogo Electric Co., 319 North Queen St., Lancaster, $790. Grand total $706,704. Noted Aug. 7.

**Ont., Toronto**—GARAGE—Toronto Transportation Comn., 35 Yonge St., general contract 2 story, brick, concrete, stone addition, Davenport Rd., to Cox Constr. Co. Ltd., 46 King St., W. Total est. $150,000. Plumbing, heating, to W. J. McGuire Ltd., 91 Jarvis St.; electrical work, to Harris & Marson, 81 Parkway Ave.; gypsum roofing, to Gypsum, Lime & Alabastine, Canada Ltd., Federal Bldg.

**Que., Montreal**—EXCHANGE—Bell Telephone Co., toll building, Belmont St., to Corinthian Constr. Co., 1184 Ste. Catharine West. $1,000,000.

# Buildings

## FACTORIES AND MILLS

### PROPOSED WORK

**Calif., King City**—MILK PRODUCTS PLANT—Lactol Corp., 203 California St., San Francisco, 1 story, 30 x 60 ft. fireproof milk products plant. Private plans.

**Calif., Los Angeles** — MANUFACTURING PLANT — Consolidated Steel Corp., 1200 North Main St., sketches 10 or more buildings, incl. shops, office, warehouse, water tank, brick, steel, Slauson and Eastern Aves. To exceed $100,000. Private plans.

**Calif., Oakland**—PLANT—Herrick Iron Wks., 18th and Campbell Sts., purchased 1 square block site and plans extensions. **Maturity 1931.**

**Calif., Richmond** — FACTORY — Richmond Paint Products Co., 1401 Barrett Ave., 1 story, brick, galvanized iron. $40,000. Private plans.

**Calif., San Francisco**—COLD STORAGE and DISTRIBUTING PLANT — General Petroleum Corp., of California, 310 Sansome St., cold storage and distributing plant in North Beach Dist. $1,000,000. Private plans.

**Calif., San Francisco**—CREAMERY—D. A. Reidy, archt., Pacific Bldg., soon takes bids 2 story, (ultimately 4 story), basement, rein.-con., 18th and York Sts., for Challenge Creamery & Butter Assn., 307 Montgomery St. To exceed $40,000.

**Conn., Orange** — POPCORN FACTORY — George's Honeykiss Popcorn Co., Inc., c/o L. J. A. Julianelle, archt., Metropolitan Bldg., New Haven, 1 story, 50 x 200 ft., brick, steel, granite. $55,000.

**D. C., Wash.**—FACTORY—O. J. Maigne Co., 356 Pearl St., New York, bids after Jan. 1, 3 story printers rolls factory, Georgia Ave. $100,000. Dodge & Morrison, 160 Pearl St., New York, archts. Noted June 12.

**Mass., Fitchburg** — MANUFACTURING — Simonds Saw & Steel Co., 55 North St., 360 x 550 ft., brick, concrete steel, $1,000,000. J. O. DeWolf, 45 Bromfield St., Boston, engr. Noted Aug. 21.

**Mo., Jefferson City** — NEWSPAPER PLANT and OFFICE—Post-Tribune, c/o R. C. Goshorn, secy.-treas., 217 East Capitol Ave., rein.-con., brick. $75,000.

**N. J., Bound Brook**—FACTORY—Pathe Exchange, Inc., Middlesex Boro, sketches by J. N. Pierson & Son, 198 Jefferson St., Perth Amboy, 1 story, basement, brick. $40,000.

**N. J., Hillside**—FACTORY—Union Carbide & Chemical Co., subsidiary Union Carbide & Carbon Corp., 30 East 42nd St., New York, pyrofax gas factory, Ramsey Ave. $40,000. Architect not selected.

**N. Y., Brooklyn**—BAKERY—Monroe Realty & Mortgage Co., B. Pecher, pres., 468 Cherry St., plans by McCormick Co., 41 Park Row, New York, 100 x 150 ft., Coney Island Ave. and Avenue U. $125,000.

**N. Y., Brooklyn**—ICE PLANT—Paramount Ice Co., 241 Ellery St., plans by G. J. Lobenstein, 885 Flatbush Ave., 100 x 150 ft., Steuben St. and Myrtle Ave. $60,000.

**N. Y., Long Island City**—MANUFACTURING—H. B. Schuhoff Inc., 1440 Bway., plans by Seelig & Finkelstien, 153 Pierrepont St., Brooklyn, 3 story, 60 x 90 ft. manufacturing, 34th St. and 37th Ave. $70,000.

**N. Y., Syracuse**—BOILER FACTORY—Pierce, Butler & Pierce Mfg. Corp., 41 East 42nd St., bids in December, general contract boiler manufacturing plant. To exceed $40,000. Private plans. Noted June 12.

**O., Cleveland** — FACTORY, etc. — Cleveland Wire Wks. of General Electric Co., c/o E. G. Edwards, mgr., plant extensions, Nela Park, 1 story, 320 x 370 ft., brick, steel factory, power house, Chardon Rd. $400,000. Private plans.

**O., Cleveland**—FACTORY—Dobeckmun Co., c/o George S. Rider Co., archts., Marshall Bldg., 1 story, 100 x 262 ft., brick, steel, Monroe Ave. $100,000.

**O., Lorain** — CREAMERY PLANT — Lorain Creamery Co. plans by L. J. Weiskopf, 7016 Euclid Ave., Cleveland, 1 story, 55 x 115 ft., brick, steel, 14th and Oberlin Sts. $40,000.

**Va., Hopewell** — COLD STORAGE and REFRIGERATION—Southside Marketing & Finance Corp., B. F. Harris, pres., Petersburg, cold storage and refrigeration plant.

**Ont., Barrie** — PACKING PLANT — E. M. Nielson, archt., Botfield St., Islington, soon takes bids 3 story packing plant, for First Cooperative Packers of Ontario Ltd., J. Little, vice pres., Shelbourne.

**Ont., Brockville**—WIRE FACTORY—Eugene F. Phillips Electrical Wks. Ltd., 12 Mercer St., Toronto, plans by J. M. Miller, 648 Dorchester St., Montreal, Que., 3 units, 1 and 2 story, concrete, steel, brick additions. $200,000.

**Ont., Sandwich**—DISTRIBUTING PLANT, etc.—British American Oil Co. Ltd., Royal Bank Bldg., Toronto, gasoline and oil distributing plant, storage tanks, concrete founds., also garage. $250,000. Private plans.

**Ont., Sault Ste. Marie**—STEEL MILL—Algoma Steel Corp., altering and constructing addition to rail and structural steel mill. $1,250,000.

### BIDS ASKED

**Calif., Hollywood**—NEWSPAPER PLANT—F. D. Rutherford, archt., Mills Bldg., Santa Monica, taking bids 2 story, basement, 144 x 145 ft., Wilcox Ave., for News Publishing Co. $200,000 or more. Noted Aug. 21.

**Mass., Springfield** — PLANT — McClintock & Craig, engrs., 458 Bridge St., taking bids coal handling plant, single conveyor, concrete, for United Electric Co., 73 State St.

**N. J., Paterson**—FACTORY—Lee & Hewitt, archts., 152 Market St., bids about Oct. 1, general contract 2 story, basement, 65 x 105 ft., brick, steel, for J. S. Royal, c/o architect. Noted Aug. 28.

**N. Y., Long Island City** — CLEANING and DYEING PLANT — Colonial Dye Wks., c/o I. Fenichel, archt., 114 East 32nd St., new bids about Sept. 15, general contract 3 story plant. Former bids rejected. Noted Apr. 24.

**N. Y., Long Island City**—FACTORY—Paragon Paint Co., 47-10 St., bids about Oct. 15, general contract 100 x 100 ft. factory, 10th St. and Vernon Ave. $150,000. L. A. Abramson, 46 West 46th St., New York, archt. Noted July 3 Daily.

**N. Y., New York**—FACTORY and WAREHOUSE—Starrett Bros. & Eken, Inc., contractors, 101 Park Ave., taking bids separate contracts 18 story, 11th to 13th Aves., 26th and 27th

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**Factories and Mills (Continued)**

Sts., for Starrett Investing Corp., 101 Park Ave. Est. $4,000,000. Noted July 31 under "Contracts Awarded."

**R. I., Providence**—BULK STATION—Texas Co., Park Sq. Bldg., Boston, Mass., taking bids bulk station, Eddy St. $40,000 or more. Private plans.

**Ont., Owen Sound**—PLANT—See "Contracts Awarded."

**CONTRACTS AWARDED**

**Calif., Salinas** — PLANT — Amer. Rubber Products, Inc., Matson Bldg., San Francisco, 1 story, 100 x 102 ft., concrete, corrugated iron. Spencer Switch, to E. F. Reese, 158 Central Ave., $150,000.

**Idaho, Caldwell** — CREAMERY — Dairyman's Co-operative Creamery of Boise Valley, c/o J. R. Bwon, mgr., Boise, 1 story, 132 x 200 ft. creamery, day labor, under supervision. Austin Co., engrs. Dexter-Horton Bldg., Seattle, Wash. $101,200.

**Ill., Belleville** — STOVE MANUFACTURING PLANT — Baker-Nagle Co., 913 Freebueg Ave., 1 story, 95 x 135 ft., concrete, brick addition, to Bauer Bros. Constr. Co., 424 Lebanon St. Est. $40,000.

**Ill., Chicago**—FACTORY—Albright-Nell Co., 5315 South Western Ave., masonry and carpentry contract 1 story, 140 x 200 ft. brick addition, to G. A. Nordgren & Co., 189 West Madison St. Est. $55,000.

**Ill., Chicago**—FACTORY—Squire Dingee Co., 1918 Elston Ave., masonry and carpentry contract 4 story, 88 x 151 ft., brick, 1850-64 Besley Ave., to H. W. Greene, 400 West Madison St. Est. $70,000.

**Ind., Laporte**—NEWSPAPER PLANT—Laporte Herald, general contract 2 story, basement, 110 x 120 ft., brick, steel, State and Monroe Sts., to Larson-Danielson Constr. Co., Laporte. Est. $60,000.

**Mass., Cambridge**—POTTERY PLANT—A. H. Hews & Co., Inc., 205 Richdale Ave., pottery plant, to Stone & Webster, Inc., 49 Federal St., Boston. Est. $50,000. Noted Sept. 4.

**Miss., Corinth** — MILLS — Corinth Hosiery Mills, c/o Chamber of Commerce, 1 story, 199 x 227 ft., concrete, brick, saw tooth construction, incl. 80 full fashioned machines, auxiliary equipment, to H. A. McGuire, Dermon Bldg., Memphis, Tenn., $92,960.

**Neb., Omaha**—OIL PLANT—Quaker Petroleum Co., 14th and Nicholas Sts., general contract 1 and 2 story, basement, 56 x 210 ft., brick, concrete, and 60 x 96 ft. brick, concrete oil compounding and barreling plant, to Parsons Constr. Co., Grain Exchange Bldg. Est. $50,000. Noted June 26.

**N. J., Orange**—DISTRIBUTION PLANT—Public Service Electric & Gas Co., 80 Park Pl., Newark, general contract 2 story, basement, 90 x 100 ft., brick, rein.-con., Lakeside Ave. and High St., to United Engineers & Constructors, Inc., 80 Park Pl., Newark. Est. $150,000.

**N. Y., Albany**—LAUNDRY—Morgan Linen Co., 115 South Swan St., laundry, to Feeney & Sheehan, 164 Montgomery St., Albany. Est. $200,000. Noted June 12.

**N. Y., Gouverneur**—FACTORY—Horton Ice Cream Co., 205 East 24th St., New York, brick, concrete addition, to Peirson Bros., 215 43rd St., Brooklyn. Est. $60,000.

**O., Cleveland**—LAUNDRY, etc.—Dpt. P. Welfare, K. T. Connar, supt. Dpt. Wks., Columbus, brick, concrete, incl. equipment, at Cleveland State Hospital, to Dawson & Finan Co., 1276 West 3rd St., $27,000. Noted May 1.

**Pa., Clairton** — COAL WASHING PLANT — Carnegie Steel Co., Carnegie Bldg., Pittsburgh, coal washing plant, to Koppers Rheolaveur Co., Koppers Bldg., Pittsburgh. Est. $2,000,000.

**Pa., Uniontown**—RADIATOR PLANT—Richmond Radiator Co., 1480 Bway., New York, 1 story, 50 x 160 ft. warehouse, 2 story, 32 x 56 ft. gas boiler plant, 1 story, 22 x 48 ft. machine shop addition, 1 story, 16 x 48 ft. blacksmith shop, to Hankins Paulson Co., 108 North Beeson St.

**Wis., Milwaukee**—FACTORY—Nordberg Mfg. Co., general contract 1 story, 85 x 87 ft. addition, Oklahoma St., to Bentley Bros., Inc., 808 Pierce St. Est. $42,000.

**Ont., Copper Cliff**—REFINERY—International Nickel Co., converting mostly 1 story, rein.-con., steel smelter into refinery, to Fraser-Brace Eng. Co. Ltd., 107 Craig St. W., Montreal, Que. Est. $2,000,000.

**Ont., Owen Sound**—PLANT—Dominion Linseed Co. Ltd., 2 story, basement, rein.-con., steel extension, incl. 75,000 bu. storage elevator, 20,000 gal. molasses tank, day labor. $75,000. N. Bowman, 5th St. E., engr.

**Ont., Toronto**—CHARCOAL STOREHOUSE, etc.—Canadian Pacific Ry., J. M. R. Fairbairn, ch. engr., Windsor Sta. Montreal, Que., 1 and 2 story, concrete, brick, timber storehouse, yard office, charging plant, dope retaining building, shelter, repair shop, linen storage, truck platforms, 2 standpipes, bunk house, addition to roundhouse, concrete foundations, Fleet and John Sts., to Anglin-Norcross Ltd., Temple Bldg. Est. $500,000.

## GARAGES

**PROPOSED WORK**

**N. Y., Brooklyn** — Borden Co., 350 Madison Ave., New York, plans by M. Klein, 65 Court St., 2 story, 80 x 100 ft. service garage, Madison and Throop Aves. $60,000.

**N. Y., Brooklyn**—Central Concrete Mixing Co., A. Clarke, pres., 572 Smith St., plans by P. Freshman, 50 Court St., 67 x 105 ft. service garage, King and Dwight Sts. $40,000.

**N. Y., Brooklyn**—O. Curth, Saratoga Ave. and Macon St., plans by Allmendinger & Schlendorf, 1 Hanson Pl., altering, 2 story service garage, Saratoga Ave. and Macon St. $40,000.

**N. Y., Brooklyn**—Dpt. Hospitals, Municipal Bldg., bids in November, garage and mortuary, Ocean Parkway and Avenue Z. $150,000. G. M. McCabe, 96 5th Ave., New York, archt.

**N. Y., Brooklyn**—Guida Holding Corp., 1085 East 42nd St., plans by M. Klein, 65 Court St., 100 x 100 ft. service garage, 51st St. and Foster Ave. $40,000.

**N. Y., Brooklyn**—M. Kessler, 211 West 106th St., New York, plans by M. Klein, 65 Court St., 73 x 117 ft. service garage, Hart Pl. and West 16th St. $56,000.

**N. Y., Brooklyn**—J. Kostman, Flatbush and Nostrand Aves. plans by F. H. Klie, 250 Park Ave., New York, altering, fireproofing and constructing 2 story service garage addition, Flatbush and Nostrand Aves. $40,000.

**N. Y., New York** — Samay Realty Co., 225 West 34th St., S. Snow, pres., new bids after Oct. 15, general contract service garage, $200,000. W. C. Sommerfeld, 31 Union Sq., archt. Noted June 19.

**N. Y., Brooklyn**—R. Sanders, 494 14th St., plans by F. H. Klie, 250 Park Ave., New York, 2 story, 50 x 163 ft., brick, concrete, Prospect and 5th Aves. $75,000.

**N. Y., Brooklyn**—N. Spitzer, 3026 Lakeland Pl., plans by H. J. Nurick., 44 Court St., 90 x 100 ft. service garage, 3rd Ave. and 67th Sts. $50,000.

**N. Y., Flushing**—S. Lax, 4556 171st St., plans by B. Bruanstein, 163-18 Jamaica Ave., Jamaica, 189 x 275 ft. service garage, Willets Pt. and 36th Ave. $50,000.

**N. Y., Jamaica**—Corporation, c/o A. McLean, archt., 149-27 Jamaica Ave., 117 x 167 ft. service garage, Bellaire St. and Jamaica Ave. $40,000.

**N. Y., New York**—Six Hundred Thirty West 55th Street Corp., M. Natanson, pres., 527 5th Ave., plans by F. S. Parker, 119 West 57th St., 6 story, 100 x 200 ft. garage and light manufacturing plant, 630 West 55th St. $400,000.

**BIDS ASKED**

**Calif., Riverside**—See "Streets and Roads."

**CONTRACTS AWARDED**

**Ind., Indianapolis** — Standard Oil Co., 137 West 11th St., general contract rein.-con., brick, steel super-service station, New York St. and Capital Ave., to Krebay Constr. Co., 108 East Pratt St. Est. $42,300.

**Mass., Cambridge**—American Oil Co. of Massachusetts, c/o R. T. Jackson, archt., 44 School St., Boston, substructure for 1 story, basement, brick, rein.-con., steel garage and super service station, 104 Mt. Auburn St., to W. T. Powers Co., 24 Union Sq., Somerville. Architect taking bids on superstructure. Noted Aug. 28.

**Mo., Independence**—See "Proposed Work."

**Pa., Aliquippa**—Sterling Oil Co., R. S. Newton, in charge, Emlenton, 1 story, brick, tile super-service station, Franklin Ave., to Franklin Lumber Co., Station St. Est. $40,000.

## SHOPS AND FOUNDRIES

**PROPOSED WORK**

**Calif., South San Francisco**—SHOP—Pacific Coast Steel Co., 215 Market St., San Francisco, plate manufacturing shop. $60,000. Private plans.

**N. Y., Brooklyn**—SHOP, etc.—R. H. Macy, 34th St. and Bway., New York, plans by R. D. Kohn, 56 West 45th St., New York, 153 x 256 ft. shop, garage and storage, Glenwood Rd. and Schenectady Ave. $200,000.

**N. Y., Brooklyn** — SHOP — M. H. Renken Dairy Co., 584 Myrtle Ave., plans by Koch & Wagner, 32 Court St., altering shop and garage, Classon and Myrtle Aves. $40,000.

**CONTRACTS AWARDED**

**N. Y., Brooklyn**—IRON FOUNDRY—Lee & Hewitt, archts., 152 Market St., Paterson, N. J., general contract 2 story, basement, brick, steel, plain found., to S. Glicksman, 347 Beach 21st St., Far Rockaway, for Brooklyn Brass Wks., 263 Scholes St. Est. $40,000. Noted July 24.

**Pa., Oil City**—SHOP and LABORATORY—Independent Oil Refining Co., S. Ericson, in charge, 1 and 2 story, brick, steel, Seneca Street Extension, to L. O. Boquin Co., 13 East 1st St. Est. $40,000.

## POWER PLANTS

**PROPOSED WORK**

**Conn., Danbury** — Danbury & Bethel Gas & Electric Light Co., 238 Main St., plans by Sunderland & Watson, 248 Main St., brick, steel warehouse, garage and service building, State St. $50,000 or more.

**Kan., Holton** — City soon takes bids power plant addition. $65,000. Black & Veatch, 700 Mutual Bank Bldg., Kansas City, Mo., engrs.

**Mass., Natick** — Mexican Petroleum Corp., Park Sq. Bldg., Boston, 1 story, concrete service station, East Central and Union Sts. $40,000. Private plans.

**Mass., New Bedford** — A. Akulski, 82 Cove St., 1 story, concrete garage, repair shop and service station, Cove and Viall Sts. $40,000. Private plans.

**Mo., Independence**—City, J. Craig, clk., 41 x 50 ft. steel, brick, boiler plant, 52 ft. high, boiler settings, piping, air ducts, $110,000. Black & Veatch, Mutual Bldg., Kansas City, engrs. Two 500 hp. boilers, 1 air preheater, 1 chain grate stoker and 2 superheaters, to Babcock & Wilcox Co., 4459 Manchester Ave., St. Louis, $54,200; machine tools, to English Bros. Mchy. Co., 410 West 5th St., Kansas City, $2,459; self-cleaning air filter, to C. H. Carr & Co., 411 Mutual Bldg., Kansas City, $1,037; extraction heaters, to L. A. Stephenson, $804. Grand total $58,500.

**N. Y., Brooklyn**—Brooklyn Hospital, Inc., A. Van Sinderen, pres., plans by Lord & Hewlett, 2 West 45th St., New York, altering 3 story refrigeration plant, DeKalb and Ashland Aves. $40,000.

**N. Y., New York**—New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., plans by O. H. Marritt, 466 Lexington Ave., 60 x 92 ft. substation, 316 West 66th St. $110,000.

**O., Cleveland**—See "Factories."

**Okla., Vinita**—City sketches municipal light plant. $200,000. Russell & Axon, McDaniel Bldg., Springfield, Mo., engrs.

**W. Va., Wheeling**—Wheeling Garage Corp., soon takes bids 2 story, basement, 33 x 128 ft., brick, steel, concrete, Chapline St. $50,000.

**BIDS ASKED**

**La., Morgan City**—Sept. 16, by City, power plant, waterworks, incl. two 400 kw. oil engine generating sets, switchboard, two 1,000 g.p.m. motor driven and two 350 g.p.m. domestic service motor-driven pumps, one 1,000 g.p.m. and one 3,000 g.p.m. low head motor-driven pumps, one 12,000 gal. oil storage tank, machine foundations, electric transmission system, 5,700 ft. 10-in., 1,500 ft. 6-in. B.c.i. pipe, hydrants, valves, boxes. Swanson-McGraw, Inc., 426 Balter Bldg., New Orleans, engrs. Noted July 31.

**Mass., Cambridge**—See "Contracts Awarded."

**CONTRACTS AWARDED**

**N. J., Jersey City** — Bd. City Comrs., City Hall, furnishing, installing boilers and mechanical equipment, for power house Jersey City Hospital, to F. P. Farrell, 269 Camden St., Newark, $238,704.

## WAREHOUSES

**PROPOSED WORK**

**Calif., San Francisco**—Poultry Producers of Central California, 700 Front St., plans by H. C. Baumann, 251 Kearny St., 3 story, basement, rein.-con., Vallejo and Sansome Sts. $150,000.

**Minn., Hibbing** — Great Northern Iron Ore Properties, 509 3rd Ave., soon lets contract 2 story, basement, brick, steel, rein.-con. warehouse. $60,000. B. M. Conklin, archt., and Arthur Mining Co., engr., both 509 3rd Ave.

**N. Y., Brooklyn**—Franklin F. P. Warehouses, Inc., 84 Rockwell Pl., plans by G. S. Kingsley, 103 East 125th St., New York, 8 story, 99 x 100 ft. storage warehouse, Rockwell Pl. and Fulton St. $250,000.

**N. Y., Brooklyn**—W. R. Thomas, Gravesend Ave. and Cortelyou Rd., plans by G. S. Kingsley, 103 East 125th St., 5 story industrial storage, Gravesend Ave. and Cortelyou Rd. To exceed $75,000.

**N. Y., New York**—New York Central R.R. Co., F. B. Freeman, ch. engr., Grand Central Terminal, plans by DePace & Juster, 151 West 46th St., 8 story, 200 x 257 ft. warehouse, garage, 101 West End Ave. and 302 West 65th St. $1,500,000.

**N. Y., Brooklyn**—P. F. Reilly's Sons, 491 Bergen St., plans by F. O. Lewis, 51 East 42nd St., New York, 9 story, 60 x 100 ft. storage, Bergen St. and 6th Ave. $150,000.

**O., Cleveland** — New York, Chicago & St. Louis R.R., A. C. Harvey, ch. engr., plans by G. Herr, c/o owner, 1 story, 80 x 613 ft. and 35 x 114 ft. warehouses, 2 story, 35 x 270 ft. storage building, all brick, steel, East 40th St. and Lakeside Ave. $250,000.

**CONTRACTS AWARDED**

**Calif., Los Angeles**—Los Angeles Soap Co., 717 East 1st St., 5 story, basement, 50 x 100 ft., rein.-con., Class A, Banning St., to Baruch Corp., Lincoln Bldg.

**Ill., Chicago**—American Can Co., 104 South Michigan Ave., masonry contract 1 story, brick boiler room and 58 x 94 ft. warehouse addition, 5947-6007 South Western Ave., to M. Thompson, 6005 Southwestern Ave., $120,000.

**Mass., Quincy** — Bethlehem Ship Building Corp., East Howard St., 2 story, 100 x 200 ft., brick, rein.-con., steel, plain found., East Howard St., to H. L. Hauser Building Co., Inc., 263 Summer St., Boston. Est. $40,000 or more.

**Pa., Connellsville**—Canstan Glass Co., 1 story, 200 x 440 ft., corrugated asbestos, steel, concrete, to Austin Co., Union Trust Bldg., Pittsburgh. Est. $150,000.

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***See proposal advertising on page 150***